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THE ORIGIN OF MAN FROM A BRACHIATING ANTHROPOID STOCK

By Professor WILLIAM K. GREGORY

AMERICAN MUSEUM OF NATURAL HISTORY

I. A COMPARISON OF THE LIMBS, HANDS AND FEET OF MAN, ANTHROPOID APES AND PRIMITIVE EOCENE MAMMALS[1]

RECENT attacks on the "ape-man theory" by Professor Henry Fairfield Osborn have been misinterpreted by many newspaper writers and preachers to mean that what they choose to call the Darwinian hypothesis of man's origin has been demolished by America's foremost paleontologist, so that many now feel that man's anatomical bonds with the apes may safely be ignored or explained away. It is true that in stressing the wide psychical gulf between man and the apes Professor Osborn did not at first explicitly provide his "Pro-Dawn Man" with any assignable ancestors among the lower mammals. But those who prematurely welcomed Professor Osborn to the ranks of the anti-evolutionists seem to have overlooked several striking passages in his recent Des Moines address.[2] Here he definitely states that he is "not ignoring the overwhelming evidence of a remote community [of] origin between man and the anthropoid apes"; and that he is only "combating the special feature of the Lamarck-Darwin hypothesis that man once passed into highly specialized arboreal adaptations attained by the Miocene apes"; finally, he is "inclined to separate the human stock at a geologically earlier pre-Miocene period of anthropoid evolution." Moreover, Professor Osborn's diagram illustrating his "present theory of the ascent and phylogeny of man" agrees in general with my "family tree of man" (1921, 1924),

[1] Based on papers read before the Charlottesville, Virginia, meeting of the American Association of Anatomists and the American Association of Physical Anthropologists, April 18 and 19, 1930.

[2] SCIENCE, 71: 1–7, January 3, 1930.

the chief difference being that the point of initial differentiation of man and the anthropoid apes is placed one geologic epoch earlier in his diagram than in mine. Hence that which was often represented in the public press as a revolutionary overturning of the Darwinian hypothesis of man's origin differs only in details from that version of the Lamarck-Darwin theory which has been developed and expounded by Sir Arthur Keith since 1893, by Professor G. Elliot Smith for many years past and by the present speaker since 1916.

A careful study of Professor Osborn's recent papers shows that there are not less than fourteen points in which his theory is in entire accord with that which I am defending. These fourteen points will be discussed in the paper of which this is an abstract. On the whole they will probably arouse far less dissension in the world than did the fourteen points of Professor Osborn's former colleague at Princeton. Certainly they afford a basis for further progress toward agreement, especially since Professor Osborn concedes: (*a*) "the overwhelming evidence of a remote community [of] origin between man and the anthropoid apes"; (*b*) "the strong evidence for an Eocene arboreal stage in our ancestry," and (*c*) that "in the forest remain all the backward, conservative types, while on the plateaus and uplands are found the alert, progressive, forward-looking types." Thus we have made progress toward the conclusion that although man may have been a plateau-living biped for millions of years, his ancestry eventually merges with that of the conservative forest-living, originally arboreal anthropoids.

There are, however, ten remaining points in which Professor Osborn's theory diverges from mine, all of which are discussed in this paper as it will appear in the *American Journal of Physical Anthropology*. Of these, the most fundamental difference is that while admitting the existence of a common ancestral stock from which man and the anthropoid apes are both derived, Professor Osborn eliminates from the human line the "brachiating stage" through which the early anthropoid undoubtedly passed, while Keith, Gregory, Morton and others regard at least a moderate amount of brachiation as an indispensable prerequisite for the assumption of erect bipedal posture on the ground. Brachiation, as first used by Keith, means that method of progression in the trees in which the suspension grasp is employed by the arms, which are held above the head, while the backbone is in general vertical to the plane of progression. One need hardly say that the hind limbs of brachiators are of the grasping type. Other modes of progression are of course employed by the chimpanzee and gorilla when on the ground, and they do not invariably brachiate even when in the trees. Nevertheless they are evidently derived from partly brachiating ancestors, as shown by the construction of their skeletons.

In his Des Moines address referred to above, Professor Osborn did not discuss in detail the great mass of osteological and other anatomical evidence for the descent of man from early brachiating ancestors which has been set forth by Keith, Morton, Gregory, Schultz and others. He merely implied that resemblances of this kind might be due to the independent derivation of man and the anthropoid apes from Eocene mammals with divergent first digit. It is this last suggestion of Professor Osborn's that I desire to consider here.

At one time or another I have examined practically all the known types of hands and feet of Eocene insectivores, carnivores, protoungulates, artiodactyls, perissodactyls, rodents, edentates and primates. Many of these will shortly be described in Professor W. D. Matthew's memoir on the fossil mammals of the Lower Eocene. In all the more primitive representatives of the Eocene groups the hand is pentadactylate with a somewhat fan-shaped radiation of the metacarpals and digits. The thumb is well developed and divergent. The carpus is shallow, the bones in general being more or less widened, except the magnum or capitate, which in the front view is quite small. The centrale is distinct. The ungual phalanges are compressed and doubtless have sharp claws. This general type of hand was probably very near to the basic type for all the placental orders, but it has not taken even the initial steps toward the human type. None of the hands of non-primate mammals of Eocene age therefore offer any evidence in favor of Professor Osborn's suggestion that the human hand may be derived independently of the anthropoid ape type from some primitive Eocene mammal with a more or less divergent thumb.

The generalized primate type of hand was already in existence in Eocene times and had advanced far beyond the generalized placental type described above. In the Eocene lemuroid genus *Notharctus*, elsewhere described by me, the fingers are long and slender, the thumb relatively short but mobile, the capitate or magnum is extended vertically and the carpus decidedly narrow as compared with that of the ordinary Eocene mammal. This was the primary arboreal adaptation of the primate hand in Eocene times, and even in man the hand still abounds in unmistakable tokens of derivation from arboreal ancestors.

If we compare, for example, the skeleton of the hands of man, gorilla and chimpanzee, we shall see that while the hand of man is extremely different from that of the prototypal Eocene mammal, it is extraordinarily close to that of the gorilla in its fundamental

features, differing chiefly in the length of the thumb and the shortness of the metacarpals.

Many deep-seated resemblances between man and the gorilla are to be seen in the carpal bones. In both forms the navicular (scaphoid) is placed vertically in a peculiar way so that the articular surface extends from the lunate down past the upper end of the capitate (magnum) to the lesser multangular (trapezoid). Almost every process on the carpal elements of gorilla is represented by a more or less reduced process in man. These processes are better seen in the so-called primitive races, such as Australians and Negroids, than in the more or less reduced, degenerate hands of pen-using white men.

Along with these resemblances between man and gorilla are numerous differences in the carpals of these two forms. Here belong especially the reduction of the pisiform in man, the enlargement of the lesser multangular in the rear view, the reduction of the great processes on the palmar side of the hamate, capitate (magnum), etc. These differences are doubtless associated partly with the fact that the gorilla still uses its hands in locomotion, while in man this function has normally long since been given up.

The persistence of so many and great resemblances notwithstanding the marked differences in locomotor habits between gorilla and man assuredly testify to the arboreal heritage of the human hand. Of all the anthropoids the nearest approach to man in the general construction of the bony hand is made by the gorilla. Now the gorilla, as may be testified from field experience, has not yet given up wholly the brachiating habits of his ancestors. Hence I infer that the strong resemblance in the hand skeleton of gorilla and man supports my contention made on other grounds that the skeleton of man retains many unmistakable souvenirs of a former brachiating stage.

If all these striking resemblances both in the skeleton and the general anatomy between the hand of man and that of the chimpanzee and gorilla are to be ascribed solely to parallelism, then what sort of morphological evidence would ever be accepted as evidence of genetic affinity?

If such degrees of resemblance between man and gorilla held only in the comparison of the hands alone, those who ascribe these resemblances to convergence or parallelism might have a stronger case, but the fact is that similar degrees of resemblance, associated also with differences, may be found in many other parts of the skeleton and soft anatomy.

Since space is lacking for the comparison of many parts of the skeleton of man with those of anthropoid apes and Eocene mammals, I shall deal here only with the humerus and the foot.

The facts show that the humerus of man is incomparably nearer to that of the brachiating chimpanzee than it is to the humeri of relatively primitive quadrupedal mammals of the Eocene. Comparative study shows that the humeri of the primitive Eocene mammals, which so far as known were all quadrupedal either on the ground or in the trees, have a relatively short stout shaft, the so-called supinator crest is large and prominent, there is a large entepicondylar foramen, the deltopectoral crest is flaring and ends above in a large greater tuberosity. In chimpanzee, gorilla and man, on the other hand, the shaft is long and narrow, the supinator crest is vertically elongate and narrow, the entepicondylar foramen is normally absent, the distal trochlea is separated from the capitellum by a prominent edge or ridge. Near the upper end the deltopectoral crest is low and vertically elongate, the bicipital groove is pronounced, the greater tuberosity is much reduced and tends to be paired with the lesser tuberosity, the head is globular and directed more upward and less backward than is the case in the humeri of Eocene quadrupedal mammals. Assuredly no unprejudiced authority, in the face of such cumulative evidence, could ascribe all these resemblances between the humerus of man and those of modern apes to pure parallelism, or still less to convergence. And it may be noted that by reason of his still essentially brachiating type of pectoral girdle, humerus, forearm and hand, man has not wholly lost the ability to brachiate effectively, at least in childhood or after practice and training.

As to the suggestion that the human foot might be derived from a generalized Eocene mammalian type with more or less divergent hallux, we may note that in these primitive Eocene mammalian feet the digits all diverge in a fan-like manner and there is as yet no suggestion of the progressive dichotomy or biramous condition which is so strongly impressed on the feet of all known primates, including those of Eocene times. This fundamentally biramous condition, which was characteristic of all the known families of Eocene primates, shows that even at this remote epoch the order of primates was thoroughly arboreal in habit. Even in man the biramous character of the foot is still so pronounced that it affords one of the clearest possible evidences that man shares with all other primates the primary arboreal heritage, while much the nearest to him in point of foot structure are the brachiating anthropoids.

In conclusion, it may be said again that the available evidence of comparative anatomy and paleontology appears to support the statement that in all the bones of his limbs, hands, feet, pectoral and pelvic girdles man is demonstrably nearer to the brachiating gorilla and the chimpanzee than to the primitive Eocene quadrupeds.

II. THE IRREVERSIBILITY OF EVOLUTION AND THE ORIGIN OF THE HUMAN FOOT

In his recent papers on the origin of man Professor Osborn has cited Dollo's "law of the irreversibility of evolution" as debarring the whole anthropoid ape group from human ancestry on account of their loss of certain anatomical characters which have been retained by man. No doubt each modern anthropoid has many of these specializations, which should not be looked for in the ancestral common stock of both apes and man. But as to the particular characters which are to be classified under this heading there is considerable diversity of opinion. The object of the present paper is to examine several well-documented cases of the irreversibility of evolution in order to determine whether my previously published views as to the evolution of the human foot and the human dentition are in accord with this principle.

The skulls of titanotheres (extinct hoofed mammals that ranged from the lower Eocene through ascending geologic horizons to the summit of the Lower Oligocene of western North America and then became suddenly extinct) are fully figured in Professor Osborn's recently published monograph on the "Titanotheres." I had the pleasure of twenty years' close association with Professor Osborn in this work and made the measurements which are the basis of the following statements.

In the Lower Eocene the skull of the very primitive titanotheres then existent was elongate and the preorbital part of the face was about 47 per cent. of the basal length of the skull. In the final stage the preorbital length had shortened to 12 per cent. Here then is an example of differential or disharmonic evolution, one part shortening, while another lengthens. Such changes in proportion have been called by Professor Osborn *allometrons*.

During the same period a pair of bony protuberances, the so-called horns, grew out above the orbits, and finally they attained an elevation above the base of the nasal bone equal to 44 per cent. of the basal skull length. Here was an example of an excessive growth concentrated in certain definite spots. Such outgrowths have been called by Professor Osborn *rectigradations*.

In the top view of these same skulls equally interesting changes take place. The earliest skulls are relatively narrow both across the cheek arches and across the parietal region. Thus in the first stage the zygomatic breadth is but 50 per cent. of the basal skull length. In the succeeding stages the skull increases rapidly in absolute length but it also increases still more rapidly in width across the zygomata, so that in the latest stage the width may rise to 87 per cent. of the basal skull length.

Here then a period of rapid widening has supervened upon an earlier period in which the skull was relatively narrow. In one of Dollo's earliest papers on the irreversibility of evolution is figured the skeleton of the foot of an Australian marsupial *Trichosurus*, which may be taken to represent an ancestral stage, already highly adapted to limb-grasping habits, while compared with this is the foot of the gigantic ground-living form *Diprotodon*, the drawing reduced to approximately the same length. It will be seen that notwithstanding the enormous thickening and enlargement of the tarsals and fifth metatarsal in order to support the gigantic weight, the heritage of a former arboreal life is deeply impressed in the peculiar characters of this foot. One may notice, for instance, the divergent position of the great toe, the subequality of digits II and III and the greater length of digit IV as compared with digit III. Digit V, however, has received a great secondary increase in size.

Here then was a capital example of the fact that evolution is irrevocable, that later stages bear in themselves the more or less visible imprint of past adaptations to earlier methods of locomotion. This case likewise clearly instances the disharmonic or differential increase of one part as compared with its neighbor which occurs when an old method of locomotion (namely, tree-climbing) is abandoned and the habit of walking on the ground is assumed.

A fourth instance of the same principle is afforded by the known facts concerning the evolution of the feet of the titanotheres, as set forth in Professor Osborn's monograph. One of his figures[3] shows the forefeet of the earliest and later members of the group drawn to the same scale. It will be seen how massive and broad the gigantic later forms are in comparison with their diminutive narrow-footed ancestors. The upper figure on the same page shows the early, middle and late stages all reduced to the same absolute height. Now in the first stage, compared with other mammals, the foot is already remarkably high and compressed, but then a period of broadening supervenes. The carpal bones become broader and flatter, the metacarpals widen at different rates so that metacarpal IV becomes nearly as wide as metacarpal III, as in the hippopotamus. Meanwhile the phalanges or true digits have suffered a marked shortening, the ungual phalanges being relatively reduced.

Thus we see in these cases that, although evolution

[3] *Op cit.*, p. 801.

is irreversible, or rather irrevocable, the tendency toward length and narrowness, which is very obvious in the earlier forms, becomes masked by a tendency toward broadening, which involves radical alteration in the general pattern of the carpal and metacarpal elements.

During the same period of evolution of the titanotheres there were marked changes in the relative lengths of the various segments of the limbs. As the animals got heavier, they gradually gave up the light springing movements of their gracefully built ancestors and took on elephantine striding movements. This change in method of locomotion was accompanied by a marked alteration in the relative lengths of the different segments of the limbs. The femur became longer, the tibia shorter and the metatarsals much shorter. In brief, there was differential or disharmonic evolution of the relative lengths of the limb segments in adaptation to a new method of locomotion.

Still greater changes in the relative lengths of the various limb segments take place when an animal habituated to one medium begins to invade another. Take, for instance, the evolutionary history of the seals. They are of course an aquatic offshoot of the order Carnivora. Although we do not know, or have not yet recognized, their direct ancestors among the terrestrial mammals of the Eocene epoch, the construction of their brains, skull, dentition, soft anatomy and skeleton indicates that these terrestrial ancestors were placental carnivores with ordinary pentadactyl hands and feet. In the group of sea-lions (Otariidae) as well as in the true seals (Phocidae) the feet have undergone profound modifications which have enabled the animals to become highly efficient swimmers. The first digit of the hand of the sea-lion has become much enlarged; the hind foot has become fan-shaped with enlarged first and fifth digits. In the true seals the hind limbs are permanently extended backward and no longer capable of being drawn forward to support the body on land.

Here then is an example of the differential enlargement of certain digits and the rotation of the hind feet through an arc of 90°. Evolution is doubtless irrevocable, but when a race migrates into a new medium a real transformation of the limbs may ensue.

The ordinary pentadactylate feet of primitive Eocene terrestrial mammals had an evenly radiating or fan-like arrangement of the digits. But when the earliest ancestors of the primates took to the trees this even, fan-like symmetry of the digits of the hind foot was disturbed by the marked enlargement of the hallux and by its wide separation from the other digits. I have elsewhere reviewed the strong evidence tending to show that this biramous arrangement of the hind foot was a primary adaptation in the entire order and that even in man there are many indubitable traces of this condition. Traces of this biramous condition seem to be especially marked in the feet of Veddahs, figured by Paul and Fritz Sarasin.

In 1916 I summarized some of the changes which would be necessary in order to derive the human foot from a gorilloid type (using that term in a wide sense). Professor Schultz, after reviewing the embryological evidence, finds that many of these changes as inferred by me are actually passed through in the embryonic history of the human foot, in spite of the fact that in many other cases the embryonic history does not repeat the phylogenetic history.

The foregoing review of examples of fairly well-documented cases of evolution shows that the transformation of a gorilloid into a human type of foot would require no unusual or unprecedented changes either in degree or in kind.

In the first place, even in such a highly specialized foot as that of man, the old biramous heritage is inescapable, so that we must infer that the binding of the great toe to the others by means of the deep transverse metatarsal ligament is surely a neomorph. As it is evident how far nature can go in pushing a digit into a new position (as when the index finger in the Koala becomes aligned with the thumb), it was surely not difficult for nature to draw the outer toes and the inner toe together and to bring about the moderate twisting of the heads of all the metatarsals that was necessary for a firm stance on the ground. These changes were effected partly also by the differential growth of all the tarsal elements: the three cuneiforms and the cuboid becoming elongate proximo-distally, the talus being displaced on to the dorsum of the arch and the calcaneum assuming a much greater burden and becoming much widened transversely. The extreme reduction of the phalanges is so obvious from a morphological view-point as to require no special emphasis.

In this case the doctrine of the irrevocability of evolution is beautifully illustrated by the obviously gorilloid heritage underlying all these special adaptations to bipedal locomotion on the ground.

III. Irreversibility and the Human Dentition

The human dentition also abounds in evidence both of the irreversibility of evolution and in traces of the derivation of man from a primitive brachiating ape ancestor of the "dryopithecoid" type. The recent intensive studies of Remane on the incisors,

canines and premolars of man have left no reasonable doubt that the small canines of man have been derived by reduction from larger and more ape-like canines or that the simple-rooted lower premolars have been derived from more ape-like conditions. Similarly as to the molars, it has been shown by Gregory and Hellman that the molar patterns of primitive man abound in souvenirs of ape ancestry.

The "*Dryopithecus* pattern" of the lower molars of apes is characterized by the possession of three large cusps on the outer side of the molar, two on the inner side, and five principal grooves, a fovea anterior or precuspidal fossa and a fovea posterior or postcuspidal fossa of Hrdlička. In the molars of the oldest known fossil men this same arrangement of five primary cusps and five principal grooves and two foveæ is incontestably present. In many primitive human molars, however, a sixth cusp is often present. In general, human lower molars are relatively wide and short as compared with anthropoid molars, a period of widening having masked an earlier, more elongate form.

In modernized human molars the *Dryopithecus* pattern is almost completely transformed, chiefly by the reduction of cusp 5 and the loss of the fourth primary groove, so that a plus pattern appears, which at first sight has very little resemblance to the primitive *Dryopithecus* pattern. The plus pattern once acquired also masks the derivation from the *Dryopithecus* pattern. But Dr. Hellman and I have traced so many intermediate stages that the reality of this transformation can be doubted only by those to whom morphological evidence makes no appeal.

In the deciduous molars of man the *Dryopithecus* pattern is fully realized in the second but only very imperfectly foreshadowed in the first. The latter, however, in man is normally much more advanced toward the molar pattern than is the corresponding tooth of the modern anthropoid apes.

In conclusion, the question whether the law of the irreversibility of evolution forbids us to attempt to derive man from a brachiating anthropoid stock allied especially with the chimpanzee and the gorilla may be posed in another way, to wit: Is there, in fact, any known fossil form (other than *Pithecanthropus* and the extinct Hominidæ of Europe) which on the one hand is evidently related to the brachiating stock and on the other hand clearly foreshadows man in many weighty characters?

Photographs of the occlusal surface of the upper and lower deciduous teeth and first permanent molars of *Australopithecus* have been received through the kindness of Professor Raymond A. Dart. This interesting fossil anthropoid from Bechuanaland was described in 1925 by Professor Dart, who has recently succeeded in separating the lower from the upper teeth. It is by his express permission that I am enabled to discuss these photographs. The first permanent lower molar has the complete *Dryopithecus* pattern, together with the sixth cusp so often found in man. The tooth is relatively wider and more human than in any fossil or recent anthropoid known to me. The first deciduous premolar is submolariform as in man and not compressed and premolariform as in the chimpanzee and the gorilla.

The upper dental arch of the same form is even more suggestive of primitive human conditions. Space is not available here for a detailed discussion of this highly significant fossil, but it may be sufficient to state that, after a very careful comparative examination, Dr. Milo Hellman and I have compiled a table of resemblances and differences which may be summarized as follows:

DISTRIBUTION OF *Australopithecus* DENTAL CHARACTERS

Nearer to chimpanzee	0
Nearer to gorilla	2
Nearer to chimpanzee and gorilla	1
Common to chimpanzee, gorilla, *Australopithecus* and primitive man	3
Transitional to, or nearer to primitive man	20
Total	26

A few points of resemblance to the orang are associated with important differences, which indicate that, on the anthropoid side, *Australopithecus* is related to the African rather than the Asiatic genera.

Now in the light of all this additional evidence, if *Australopithecus* is not literally a missing link between an older dryopithecoid group and primitive man, what conceivable combination of ape and human characters would ever be admitted as such?

Evolution is truly irreversible, but its direction can and does change. The facts set forth in many papers seem to warrant the inference that in the remote predecessors of man nature for a long period seemed bent on breeding better and better brachiators. The orang and the gibbon are her most finished products in this direction. But before completing the experiment she segregated some of the more conservative brachiators, turned them out of their forest home and started their evolution in a new direction, that of upright walking on hard ground. *Australopithecus*, to judge from its skull and dental characters, was a pioneer in the new line, as held from the first by Dart.

THE WAVE PROPERTIES OF ELECTRONS[1]

By Dr. C. J. DAVISSON
THE BELL TELEPHONE LABORATORIES

IN an essay published in a recent issue of the *Proceedings*[2] our president has explained to us the nature of thought, and has pointed out its limitations. The circumstance which prompted Dr. Dercum to undertake the exposition of these interesting matters is the difficulty experienced in physics at the present time in forming tangible conceptions of certain processes and certain relationships which have been discovered since the beginning of this century—in particular, the difficulty in forming any mental picture of the so-called quantum processes or of visualizing electrons which behave in some circumstances as particles and in others as waves.

If I follow Dr. Dercum, these difficulties in comprehension arise from limitations imposed upon our thinking processes by the nature of our neural protoplasm. If we were equipped with a better kind of protoplasm, one more completely responsive to stimulations by our environment and capable of a more varied reaction to these stimulations, our comprehension of our environment would be, or at any rate could be, more complete. Things which are incomprehensible to us with our present equipment would in these imagined conditions present fewer difficulties. An individual who has been blind and deaf since birth is capable necessarily of a less complete appreciation and comprehension of his environment than one with normal sight and hearing. And yet the individual with normal sight and hearing is, as we know, blind and deaf to great ranges of light and sound frequencies. It is conceivable even that other forms of stimulation exist in his environment for which he has evolved no receptors whatever. His conception of his environment and of the processes going on within it is, therefore, imperfect and incomplete and must forever remain so. This, as I understand it, is Dr. Dercum's thesis, and it is, I think, a comforting one, as it offers us a legitimate excuse for giving our neural protoplasm a much-needed rest. If elements in our environment are, in the nature of the case, incomprehensible to us, it is certainly foolish of us to waste time trying to comprehend them. The difficulty in pursuing this policy is no doubt that we have no test for distinguishing, *a priori*, the comprehensible from the incomprehensible.

[1] Read at the meeting of the American Philosophical Society, April 12, 1930.

[2] Francis X. Dercum, "On the Nature of Thought and Its Limitations," *Proc. Am. Phil. Soc.*, 68 (4): 275, 1929.

It is not my purpose to discuss this fascinating subject, but to explain to you, as well as I can, one of the circumstances to which it owes its present interest: namely, the duality of apparently irreconcilable wave and corpuscular properties which characterizes electrons. This matter has not, I think, been presented previously to the society. Before speaking of the newly discovered wave properties of electrons, I shall remind you briefly of some of the compelling reasons we have for regarding electrons as particles. It is important to do this in order that you may appreciate more fully the difficulty involved in regarding them at the same time as waves.

It was discovered more than thirty years ago that the many varied and often beautiful phenomena which are observed in highly exhausted electrical discharge tubes—Geissler tubes, Crookes tubes, Roentgen ray tubes and the like—are due primarily to a radiation proceeding from the cathodes of these devices. It was revealed in experiments made by J. J. Thomson in England and by Wiechert in Germany in the closing years of the last century that beams of this radiation are deflected in electric and magnetic fields, in just the manner in which we should expect them to be deflected if the radiation were a stream of swiftly moving negatively charged particles. It was found possible in fact to calculate from measurements of these deflections and other data the velocities of these hypothetical particles, and also the ratio of their electrical charge to their mass. The value found for this ratio was much greater than the largest displayed by any kind of electrolytic ion, and from this it was inferred that the particles are much lighter than the lightest atoms. This evidence of the existence of a subatomic particle of definite charge and mass was readily accepted not only because the evidence was in itself convincing, but also because the idea was not a new one. The existence of an ultimate unit of electric charge had already been inferred from Faraday's laws of electrolysis, and the word "electron" had already been coined to designate this atom of electricity. Also, Lorentz, in attempting to explain the then recently discovered Zeeman effect, had formulated a partially successful theory in which it was assumed that particles of definite charge and mass exist within the atom. The value which had to be assigned to the charge-to-mass ratio of these, in order to obtain agreement of his theory with Zeeman's observations, was the same as that found by

Thomson and Wiechert in their more direct experiments.

During twenty-five years of intensive experimentation which followed upon the work of Thomson and Wiechert, this conception of the electron as a subatomic negatively charged particle was repeatedly justified and confirmed by experiments of the most diversified kinds. Electrons were found to be a universal constituent of matter. They could be abstracted from any kind of matter in a variety of ways. They could be vaporized from matter by heating; they streamed forth under the solicitation of light and X-rays; they were ejected spontaneously by radioactive materials. Measurements were made of their charge, most precisely in the famous oil drop experiments of Millikan. By combining this result with the most reliable determinations of the charge-to-mass ratio, one could write down a value for the mass of the electron correct probably to within a few parts in a thousand. Estimates could be made of its linear dimensions on the assumption that its mass was entirely electromagnetic. If any doubt had existed regarding the corpuscular nature of electrons, it must have been dispelled by the beautiful experiments of C. T. R. Wilson in which the tracks pursued by individual electrons in traversing a gas are rendered visible. The discreteness of electrons is further attested by the fluctuations which are observed in the current flowing from a heated filament; these are of just the character and magnitude to be expected for the random emission of charges of the known magnitude of electrons.

The corpuscular nature of electronic radiations had been verified in what seemed every conceivable way. The conception seemed adequate and sufficient for all demands which might be made upon it. An elaborate theory based upon this conception of the electron had been built up to explain the optical and electrical properties of matter—and this conception was fundamental also to the famous theory of the atom devised by Bohr. It can not be said, however, that this electron theory of matter was uniformly successful in all its ramifications. It was, in fact, the deficiencies of this theory together with certain new conceptions from the field of optics which led Louis de Broglie to suggest about five years ago that the conception of the electron as a particle might in certain circumstances be found inadequate. The circumstances contemplated were those in which the system under consideration is one of atomic dimensions. It was de Broglie's idea that in cases of this kind certain waves which he conceived of as associated with electrons might be expected to manifest themselves. The conception grew out of the reverse situation in optics in which light had come to be recognized as having corpuscular as well as wave properties, out of the mysterious correlation of frequency and energy which we meet with in quantum phenomena and out of the correlation of mass and energy which appears in the theory of relativity. These were the antecedents of de Broglie's idea, and yet in the last analysis the idea was arrived at by a brilliant leap of the imagination.

It has been immensely fruitful. It has led to a new and remarkably successful conception of the atom from which the corpuscular electron as an essential feature has altogether disappeared. The planetary system of electrons conceived by Bohr is replaced by a medium continuous though inhomogeneous, capable of natural vibrations. The fact that these vibrations take place in general in a space of more dimensions than three, and that we have as yet no idea what it is that vibrates, makes visualization of atomic processes a discouraging enterprise, and yet this is less disturbing to the theoretical physicist than might be supposed. He has outgrown the ambition of Lord Kelvin; he no longer tries to devise a mechanical model of every phenomenon. It has been discovered, in fact, that a certain esthetic pleasure is derived from dealing in calculations with symbols which evoke no mental pictures whatever.

De Broglie's idea has been invaluable not only as the basis of a new theory of the atom, but also as the basis of an entirely new theory of mechanics. And in these developments de Broglie has been himself a leader. In its turn the new mechanical theory has suggested experiments by which the wavelike aspects of electrons might be demonstrated. Many of these experiments have now been made; it is of a few of them that I wish particularly to speak. The simplest of all is the experiment by which it is demonstrated that electrons are regularly or "specularly" reflected from the surface of a crystal. We find when a stream of electrons is directed against the face of a crystal that some of the incident particles return from it without loss of energy, and that most of these recede from the crystal face in the direction of regular reflection. The observation is illustrated in Fig. 1. The incident electrons approach the crystal in this particular case along a direction which makes an angle of 38° with the normal to its surface. The curve on the right indicates the way in which the electrons scattered without loss of energy are distributed in direction; most of them depart in a direction lying in the plane of incidence and making with the normal to the crystal face the same angle as the incident beam. There is a strong and well-defined beam of regularly reflected electrons.

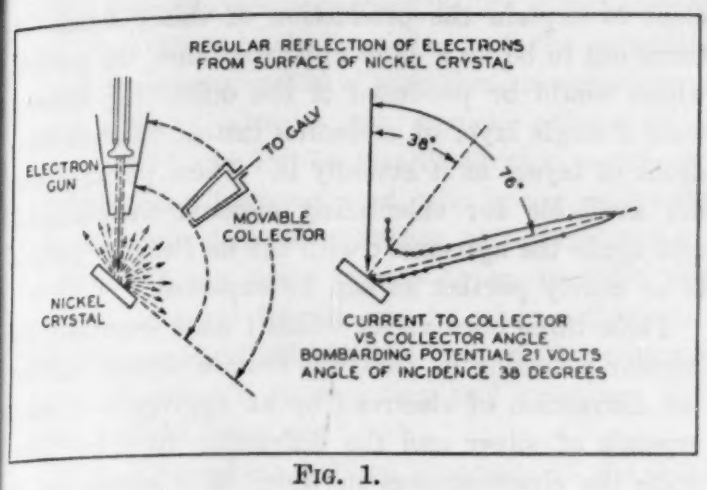

FIG. 1.

This phenomenon can not be explained in terms of atoms and electrons as previously conceived.

Picture the crystal built up of atoms, each of them enormous in size compared to an electron and each of them comprising a nucleus surrounded by a large number of electrons rotating in closed orbits. Imagine now an electron plunging into this galaxy of planetary systems. It is obviously a comet. The simplest event which may ensue will be a comet-wise deflection of the electron in the field of some atom into which it happens to strike, and then a speeding away of the electron from the crystal without loss of energy. The direction taken by the departing electron will be determined by a number of circumstances, one of which will be the distance from its line of approach to the nucleus of the atom responsible for its deflection. This distance will be different for different electrons—and as a consequence electrons will be scattered more or less uniformly in all directions. This is the picture of electrons scattering in terms of Bohr atoms and purely corpuscular electrons, and it is quite inadequate to explain the strong beam of electrons which is observed leaving the crystal in the direction of regular reflection. This is a direction related to the plane of the crystal surface. Three atoms at least are required to fix this plane, which means that the incident electron has its direction of departure determined not by one atom alone but by three atoms at least. On the older view we should have to suppose that the incident electron in some way takes account of the positions of not fewer than three atoms, and from characteristics of the reflection which I shall mention later we should have to suppose the actual number to be much greater—fifty or a hundred at least.

If, on the other hand, we regard the incident beam as a beam of waves instead of as a stream of particles, the regular reflection is readily explained; each wave-front of the beam comes in contact with all the atoms, and the regular reflection results, as in the case of X-rays, from constructive interference among the coherent secondary wave trains proceeding from the regularly arranged atoms of the crystal. Moreover, this view of the phenomenon enables us to understand the characteristics of the reflection to which I have already alluded—namely, the way in which the intensity of the reflected beam varies with the speed of the electrons and their angle of incidence.

The regular reflection of electrons from crystal surfaces is sufficient to establish the convenience of the conception that electrons are waves. The usefulness of the conception is not, however, limited to this particular phenomenon. There are many ways of demonstrating that X-rays are waves—or perhaps we should say, of demonstrating the convenience of the conception that X-rays are waves. Nearly all these demonstrations have now been made also with electrons. These include the analogues of the Laue diffraction of heterogeneous waves by a single crystal, of the Hull, Debye-Scherrer diffraction of monochromatic waves by crystal aggregates and of the diffraction of monochromatic waves by ruled gratings and narrow slits. The data of these experiments are available for the calculation of electron wave-lengths, and these have the values predicted by de Broglie—a stream of electrons, each of momentum p, behaves in these diffraction experiments as a beam of waves of wave-length inversely proportional to p, the factor of proportionality being the Planckian constant h.

To illustrate further these newly discovered properties of electrons I shall show you lantern slides of two very beautiful diffraction patterns produced recently by Drs. Eisenhut and Kaupp in the laboratory of the I. G. Farbenindustrie at Ludwigshafen in Germany. The first of these was obtained by directing a beam of high-speed electrons through a thin film of silver, and intercepting the transmitted electrons by a photographic plate. The film is an aggregate of tiny crystals of random orientation, and the pattern of rings which appears on the plate is just the pattern which is calculated from the crystal structure of silver and the assumption that the incident beam is a beam of monochromatic waves. The wave-length of the waves may be calculated from the data of the experiment and compared with the theoretical wave-length calculated from the momentum of the electrons by means of de Broglie's formula. The agreement, as has been found in all such cases, is within the limits of accuracy of the measurement. Diffraction patterns of this kind were first produced with electrons by G. P. Thomson, of the University of Aberdeen.

The second pattern I shall show you is by the same

investigators, and is for electrons of the same speed. The difference is that the diffracting material is, in this case, a thin lamina of mica. Patterns of this type were produced first by Kikuchi in Japan, and for some time there was no satisfactory explanation of them. The diffracting system is a single crystal; the electrons are homogeneous in speed, the waves are monochromatic. Now it is well known to those familiar with the theory of X-ray diffraction that in general no pattern is produced when a beam of monochromatic waves traverses a single stationary crystal. One or two diffraction beams may possibly appear, but if so the event will be fortuitous; in general no beams will be observed other than the directly transmitted primary beam. Kikuchi should have known better than to make this experiment, but he did make it, and this pattern by Drs. Eisenhut and Kaupp is a beautiful example of the result he obtained. What appears to be the correct explanation of the production of this pattern has been given us recently by W. L. Bragg in England and independently by S. B. Hendricks in Washington. Bragg and Hendricks assume that the mica crystal is to a certain extent a crystal aggregate—not an aggregate of crystals oriented at random as in the case of the film of silver, but an aggregate of tiny flakes which fail to form a perfect crystal only by being tilted slightly this way and that. This assumption together with the excessively short wave-length of the high-speed electrons employed in these experiments is sufficient to explain the production of this pattern. It turns out to be, to a close approximation, the pattern which would be produced if the diffracting systems were a single layer of molecules instead of some hundreds of layers as it actually is. These patterns also are available for calculating electron wave-lengths, and again the agreement with the de Broglie formula is as nearly perfect as can be expected.

These three phenomena which I have described, the regular reflection of electrons from a crystal surface, the diffraction of electrons by an aggregate of small crystals of silver and the diffraction by mica, illustrate the circumstances in which it is convenient to regard electrons as waves rather than as particles. Whether or not it is possible to achieve a unified conception of electrons in which these newly discovered wave properties appear consistent with their longer known corpuscular properties, or whether such an achievement is beyond the limits of thought, is a question which does not worry the experimental physicist a great deal. It used to be said that a physicist regards light as a wave phenomenon on Mondays, Wednesdays and Fridays, and as a corpuscular phenomenon on the other days of the week. This statement must now be extended to include electrons, and modified, I think, to state that he regards light and electrons as both waves and particles on all days of the week. And it might be added that familiarity with this idea is dulling his sense to its paradoxical nature.

IN HONOR OF DR. WELCH[1]

I INTENDED to throw away my manuscript, but I find that I can hardly trust myself to speak without it. I must speak in my own person and not in that of the idealized figure which has been presented to you.

It is quite beyond my power of words to express the thoughts and the feelings of gratitude which this wonderful occasion has aroused in me. Did I accept merely as a personal tribute these words of praise and this manifestation of appreciation and good-will marked by this large and distinguished gathering and by meetings elsewhere, I should be overpowered with a sense of unreality depriving me of utterance, but I shall assume, as I feel that I am justified in doing, that, by virtue of certain pioneering work and through over a half century of service, I stand here to represent an army of teachers, investigators, pupils, associates and colleagues, whose work and contributions during this period have advanced the science and art of medicine and public health to the eminent position which they now hold in this country.

It is, then, in this representative capacity, as well as personally, that, first of all, I express to you, Mr. President, immeasurable gratitude for the distinction which you lend to this occasion by your presence and active participation. You will permit me to add, Sir, that your presence and generous words of appreciation have a significance not measured solely by the high office which you hold, for you speak with the authority of one who has made memorable and outstanding contributions not only to this nation but to the whole world in the field of public health and social service, especially to the most appealing part of this domain, the health and welfare of infants and children.

And to you, President Farrand, and to you, my old friend and pupil, Dr. Flexner, who have spoken here so eloquently, even if in words all too generous so far

[1] Response of Dr. William Henry Welch, delivered in Memorial Continental Hall, Washington, D. C., at the ceremonies celebrating his eightieth birthday, April 8, 1930. The address of President Hoover was printed in the issue of SCIENCE for April 18, p. 411.

as I, personally, am concerned, to Mr. Kingsbury and the other distinguished members of the committees which have arranged this marvelous occasion, to the many citizens, also to the medical officers of the Army, Navy and Public Health Service, members of my profession here gathered, who honor me by their presence, my debt of gratitude is beyond words to express. If my voice carries to an invisible audience, to personal friends and to other gatherings in honor of my eightieth birthday and what it may symbolize, it conveys appreciation and greetings which come straight from my heart.

While I have been kept in ignorance of the details of these ceremonies, I have been cognizant that the immediate occasion was to be the presentation to me of Mr. Hutty's etching, which, I am sure, in spite of the handicap presented by the subject, he has made a work of art. This I am delighted to accept, and I am still more rejoiced that so many selected institutions and organizations with many of which I have been connected are to receive it.

If it is true, as I have been told, that there are gatherings of friends and colleagues in many places, not only in this country but also in other countries, who are interested in the event here celebrated, I only wish that the time allotted permitted me to tell them —my friends in Germany, whence came my early training and inspiration in pathology and bacteriology, my friends and colleagues in Paris, especially those at the Pasteur Institute, and those in London, Tokyo, Peking and elsewhere—to tell them how much pleasure and satisfaction and inspiration I have derived from their friendship and association. To the favor and support and cooperation of the members of my profession I owe whatever success I have attained.

No one could have been more favored in his professional career by time and opportunity, and by the good work, achievements and cooperation of pupils, assistants and associates, than I have been.

Born only three and a half years after the introduction of surgical anesthesia, I entered upon my professional career in the middle seventies of the last century, before Lister had really triumphed by the general adoption of the principles of antiseptic surgery and just before the demonstration by Pasteur and by Koch of the causation of infectious diseases by microscopic germs. I returned from Germany, thrilled with enthusiasm, at the dawn of the new era, and with some training and capacity to use that master key forged by pathology and bacteriology, which was to unlock secrets of nature destined to transform the face of modern medicine.

Since that time the fundamental achievement which has made possible the remarkable development of scientific medicine in this country during the last four decades has been the great improvement in medical education, with the accompanying creation of laboratories for instruction and research. So brilliant have been the results in discoveries and their application to the treatment and prevention of disease that one is likely to lose sight of the foundation upon which the stately superstructure rests.

Only those can realize the magnitude of this achievement who know something of the condition of medical education in this country fifty years ago, when no one dreamed of endowing medical education and research, in contrast with the condition to-day, when these subjects, together with utilization of opportunities to further and to apply the new knowledge, constitute the most favored and rewarding fields of private and public philanthropy.

I like to think that the primitive little laboratory which I started in 1878 at the Bellevue Hospital Medical College and that of Dr. Prudden, inaugurated almost simultaneously at the College of Physicians and Surgeons of Columbia University, and especially our effort to meet a much larger opportunity, at that time unique in this country, at the Johns Hopkins University and Hospital four decades ago, were not without influence in the improvement of medical education. But the accomplishment would not have acquired the national importance which it has assumed without the participation of other medical schools in the forward movement, the awakening of the medical profession through the American Medical Association and the state licensing boards, and the recognition of the great foundations, first and most important of all, the Rockefeller General Education Board, of the needs and opportunities of the situation.

If I have handed on any intellectual heritage to pupils, assistants and associates, whose work and achievements have been the greatest satisfaction and joy of my life, it is derived from that which I received from my own masters, Cohnheim, Robert Koch, Weigert and others. America is now paying the debt which she has owed so long to the Old World by her own active and fruitful participation in scientific discovery and the advancement of the science and art of medicine and sanitation.

The greatest triumphs of modern medicine have been in the prevention of disease, although the physician's power to alleviate and to heal has also been greatly enhanced. It is perhaps not too much to claim that America has taken a position of leadership in the application of the new knowledge to the prevention of disease and to personal and public hygiene.

But, my friends and hearers, it is my inclination, even at four score years, to look forward, rather than

backward, and to avoid a feeling of self-complacency through the rehearsal of past triumphs. All along the line, in the fields of medical education and research, in the study and treatment of disease and injury, in the preservation and improvement of health and the prevention of disease, so much more remains to be done than has been accomplished, the problems awaiting solution are so numerous and pressing, above all, the better utilization of existing knowledge and the need of more knowledge are so obvious and so urgent that our mental attitude should be far removed from satisfaction with existing conditions.

While public health is the foundation of the happiness and prosperity of the people and its promotion is recognized as an important function of government, how wide is the gap between what is achieved and what might be realized, how inadequate is the understanding of the public concerning the means adapted to secure the best results, how small the attractions offered to those entering or who might desire to enter careers in public health through lack of suitable financial recompense, of security of tenure of office, of opportunities for promotion, of standards for eligibility based upon special training and experience and of funds made available for the public promotion of health. Something of the lack of adjustment of the average man to rapidly changing social, economic and political conditions of our complicated modern civilization may be reflected in a certain temporary maladjustment between curative medicine and preventive medicine, which should stand in harmonious relations.

As my immediate and, doubtless, final professorial interest is on the humanistic side of medicine, I may, in closing, be permitted to emphasize the attractions and importance of studies in the history of medicine and of science. We physicians apply the word "humanism" to a period and to a spirit which released the mind from thraldom to authority and contributed mightily not merely to the study of classical antiquity but to the study of nature and of man, leading logically and rapidly to the cultivation of experimental science, between which and humanism, as we understand and use the word, there is no incompatibility whatever.

While nothing can be more hazardous than to attempt to predict the directions of future discovery and progress in the biological and medical sciences, it requires no prophetic gift to be confident that with the widening of the boundaries of knowledge will come increased power to relieve human suffering, to control disease, to improve health and thereby add to the sum of human happiness and well-being. Your presence on this occasion and the wide-spread recognition so conspicuously manifested of the value of services rendered in the field of medical education and medical science are an encouragement to teachers and workers for which I am profoundly grateful and which accentuates the note of hopefulness which I have endeavored to sound.

SCIENTIFIC EVENTS

THE ELECTION OF STATESMEN AS FELLOWS OF THE ROYAL SOCIETY[1]

THE president and council of the Royal Society have recommended Mr. Ramsay Macdonald and General J. C. Smuts for election into the society under the special statute which permits the election of "persons who in their opinion either have rendered conspicuous service to the cause of science, or are such that their election would be of signal benefit to the society." It should here be said that the inclusion of certain persons not actually engaged in scientific pursuits is a practice sanctioned by long usage. In the society's original statutes of 1663, it was provided that every one of His Majesty's subjects having the title and place of baron, or any other higher title or place, and every one of His Majesty's Privy Council, might be elected. In process of time, such persons formed a panel or privileged class. However, in 1873, there was much discussion on a motion to require in the privileged class, "evidence of ascertained special power and disposition to forward the aims of the society from exceptionally personal or official advantages of position." Arising therefrom, the privileged class was limited to princes of the blood royal and members of the Privy Council. Statutes enacted in 1902 abolished the clause relating to privy councillors and the basis of qualification remains now as quoted above. Its implications seem clear enough. The opportunities of the chief officer of state in the scientific arena are always at hand; they have nothing to do with political complexities.

In connection with Mr. Macdonald's nomination for election, it is interesting to recall that within the past sixty years four precedents can be recorded for the election of a Prime Minister whilst holding the seals of office. The instances are: Mr. Disraeli, elected on February 10, 1876; Mr. Gladstone, elected on January 13, 1881; Mr. Asquith, elected November 5, 1908; Mr. Baldwin, elected November 3, 1927. The first-named signed the charter book and was formally admitted by Dr. J. D. Hooker, the president, on June 1, 1876—fifty-four years ago—that also being the day fixed for the election of the fifteen ordinary fellows. Amongst

[1] From *Nature*.

these (and happily still with us) was Professor H. E. Armstrong. Mr. Gladstone was admitted on May 19, 1881 (Mr. Spottiswoode was president), on which occasion William Crookes read a paper, "On Discontinuous Phosphorescent Spectra in High Vacua." It fell to Mr. Asquith, in 1912, as Prime Minister, to propose "The Royal Society" at the Guildhall banquet held in connection with the two hundred and fiftieth anniversary of the Royal Society. Mr. Baldwin was formally admitted by Sir Ernest Rutherford, and a similar act when extended to Mr. Macdonald (following election) will provide the circumstance (we think without precedent) of the admission of two Prime Ministers during one presidency. The only Prime Ministers for more than half a century who have not been fellows of the Royal Society by special election or otherwise are Sir Henry Campbell-Bannerman, Mr. Lloyd George and Mr. Bonar Law.

THE ALASKA AGRICULTURAL COLLEGE AND SCHOOL OF MINES

A STATEMENT in regard to the work of the Alaska Agricultural College and School of Mines for the year 1928–1929 has been issued by the Department of the Interior. It is reported that the Bureau of Biological Survey under cooperative arrangement with the college has made very satisfactory progress with its studies in crossbreeding reindeer and caribou. It is also conducting feeding experiments with reindeer to determine the feasibility of "topping off" reindeer before the slaughtering season during later summer. Carrying capacity studies to determine actual acreage requirements of reindeer on various types of forage and plant studies to ascertain the effect of climate on forage growth have been initiated. In order to determine the digestive reaction of the reindeer to different natural forage types, digestive samples and forage samples are being collected for chemical analysis.

In connection with the projects of the Biological Survey, six pasture areas totaling 813 acres have been fenced with net wire and an additional area of 432 acres is now in process of fencing. A herd of 18 caribou and reindeer was pastured and 7 fawns were born last year. In cooperation with the Alaska Game Commission, 3 buffalo were also pastured in these corrals.

The cooperative work with the U. S. Bureau of Mines ever since the Fairbanks Station of the bureau was moved to the college has been highly satisfactory. Mineral determinations are made free of charge and for assays a nominal charge only is made.

The college is said to be strategically situated for carrying on seismological observations in liaison with other observatories throughout the world. The U. S. Coast and Geodetic Survey designed a seismograph for this service.

During the winter of 1928–29 scientific observations of the aurora were inaugurated. The preliminary observations were conducted by V. R. Fuller, professor of physics. The International Geodetic and Geophysical Union at its general assembly in Prague, Czechoslovakia, in 1927 emphasized the need for auroral observation in Alaska, and during April, 1929, the National Research Council indorsed the establishment of such an observatory at the college. The rapid commercial development of radio communication affords an immediate practical aspect to the investigation. A fund of $10,000 was recently donated to the college by the Rockefeller Foundation for this work.

Mr. Otto William Geist embarked on a two years' expedition to St. Lawrence Island collecting anthropological and ethnological specimens for the college. Previous collections made by Mr. Geist in the Bering Sea area have enriched the college museum collection by more than 7,000 items. As a result of his work the college will have an exceptional collection of Arctic specimens and in addition there will be much duplicate material for exchange purposes with other museums. Unfortunately this collection can not be properly exhibited until the college secures a fireproof museum building.

THE UNIVERSITY OF MICHIGAN EXPEDITION TO THE SAN CARLOS MOUNTAINS

AN intensive natural history survey of the San Carlos Mountains of Mexico will be undertaken this summer by a party of investigators from the University of Michigan. The region to be studied is an isolated range of mountains situated about eighty miles south of the Rio Grande, forty miles inland from the Gulf of Mexico and twenty-five miles east of the Sierra Madre front. In this area it is proposed to correlate the distribution of the living flora and fauna with the geologic formations. The San Carlos Range is well adapted for this type of investigation, because of its isolation and relief and because of the diverse types of rock formations exposed. Professor Harley H. Bartlett, head of the department of botany, and Professor Lee R. Dice, curator of mammals in the Museum of Zoology at the university, will study the flora and fauna.

The geology of the San Carlos Mountains is varied and therefore offers in a relatively small area an opportunity for intensive study in several branches of earth science. Professor Edson S. Bastin, head of the department of geology at the University of Chicago, will investigate the ore deposits. He will be assisted by Mr. George W. Rust, a graduate student of the de-

partment. Study of the igneous rocks will be carried on by Dr. Edward H. Watson, of the Johns Hopkins University. The stratigraphy and structure of the mountains will be studied by Professor Lewis B. Kellum and Mr. Ralph W. Imlay, of the University of Michigan.

The survey of the San Carlos Mountains with a view to coordinating detailed studies made by specialists in several branches of natural science was planned by Professor Kellum who made a preliminary reconnaissance of the district several years ago.

The party will spend the months of July, August and September in the field. They will make the entire trip from Michigan to Mexico and return by automobile. Each member will work independently and will have with him a mobile camp outfit. The cars can be used in the mountains between points suitable for camps. Side trips into the less accessible portions of the range must be made on horseback and on foot.

The execution of this project has been made possible by grants of $2,500 from the National Research Council and $2,000 from the Faculty Research Fund of the University of Michigan. The scientific results of the expedition will be published as a University of Michigan publication.

PLANS FOR THE NEW BIOLOGICAL LABORATORY AT HARVARD UNIVERSITY

PLANS for the new Harvard biological laboratory have been made public by the architects, Messrs. Coolidge, Shepley, Bulfinch and Abbott, and it was announced at the same time that work on two of the three wings of the building will be started in the early fall. The building of the third wing will wait on the raising of further sums of money. It is believed that this building, when completed, will be the finest and most scientifically equipped laboratory for biological research and study that has as yet been erected in this country.

The new building will be on Divinity Avenue, Cambridge, between the Farlow Herbarium and the Semitic Museum, and adjoining the present University Museum. When completed it will form a quadrangle, balancing that of the University Museum.

Designed as a research laboratory, the building will afford scientifically arranged quarters for the four departments of the division of biology, including botany, physiology and zoology and the Bussey Institution. The architecture is in the modernized Georgian style, in keeping with the surrounding buildings. It is five stories high, with red brick exterior walls on a reinforced concrete frame and white steel casement fenestration.

Two wings of the building, the right and center wings, with a combined length of approximately six hundred feet, will be constructed at this time. The left wing will be part of the proposed future addition, and with its completion a quadrangular court will be formed.

The interior of the building will provide the most complete and comprehensive facilities for the exacting and innumerable experiments of modern biological research. There are convenient laboratories of one, two, three and four units furnished with every imaginable service, rooms where the temperature can be kept indefinitely at any desired stage, rooms far underground where no outside sound can penetrate, aquarium rooms, excellently equipped photographic studios and dark rooms.

Lecture and seminar rooms are conveniently situated on all floors and in addition an auditorium seating a hundred and fifty is placed opposite the main entrance lobby. Not the least of the difficulties encountered in providing for the great numbers of laboratories and lecture rooms was the question of ventilation. An elaborate system of ducts, operated by machines on soundproof platforms in the top story, changes the air in the entire building continuously.

A large greenhouse is provided upon what would ordinarily be the roof, with arrangements for sun-seeking and shade-seeking plants and stone walls with water running down them for such plants as make their homes in water.

An unusual feature is a frieze running around the building above the upper tier of windows, formed of projecting copper-covered bosses, each showing one of the symbols of biological science.

SCIENTIFIC NOTES AND NEWS

HARVARD UNIVERSITY at its commencement exercises on June 19 conferred honorary degrees with the following citations: William Morton Wheeler—Eminent as zoologist and dean of the Bussey Institution, profound student of the social life of insects, who has shown that they also can maintain complex communities without the use of reason.—Doctor of Science. Karl Taylor Compton—A professor of physics, renowned for his contributions to its latest mysteries, the new president of the Massachusetts Institute of Technology.—Doctor of Laws.

UNION COLLEGE has conferred honorary degrees on Dr. Albert Wallace Hull, research physicist at the Research Laboratories of the General Electric Company,

and on Dr. George L. Streeter, director of the department of embryology of the Carnegie Institution at the Johns Hopkins University.

THE doctorate of laws was conferred on Edward Ray Weidlein, director of the Mellon Institute of Industrial Research, at the commencement exercises of the University of Pittsburgh.

THE University of Michigan has conferred the degree of doctor of science on Dr. Alfred F. Hess, clinical professor of pediatrics at University and Bellevue Hospital Medical College, New York City, in recognition of his work on the activation of foods and sterols by means of ultra-violet irradiations.

PROFESSOR W. D. MACMILLAN, of the University of Chicago, was given the honorary degree of Sc.D. by Lake Forest College on June 7. He delivered the commencement address on "A New Interpretation of the Old Heaven."

AT the one-hundred and first annual commencement of Illinois College on June 11, the honorary degree of doctor of science was conferred on Dr. James Bertram Overton, professor of plant physiology at the University of Wisconsin, and on Dr. George Elmer Shambaugh, professor of otolaryngology at the Rush Medical School, Chicago.

REAR ADMIRAL RICHARD E. BYRD was elected an honorary fellow of the American Museum of Natural History, the highest distinction within the gift of the trustees, at a meeting held on June 19.

DR. HENRY S. PRITCHETT, president of the Carnegie Foundation for the Advancement of Teaching since its organization in 1905, has presented his resignation to take effect on August 1. He will be succeeded by Dr. Henry Suzzallo, who is a trustee of the foundation and was formerly president of the University of Washington. As president of the Teachers Insurance and Annuity Association, Dr. Pritchett will be succeeded by Professor James W. Glover, chairman of the department of mathematics of the University of Michigan.

DR. HENRY T. FERNALD, head of the department of entomology and director of the graduate school at the Massachusetts Agricultural College, will retire from active duty as professor emeritus at the end of June after thirty-one years of service. The department of entomology will be combined with the departments of zoology and geology, of which Professor C. E. Gordon is the head. Professor F. J. Sievers, director of the experiment station, will also direct the graduate school.

THE director and secretary of the Science Museum, London, Colonel Sir Henry G. Lyons, has been reappointed to hold his present office until October, 1933. Sir Henry Lyons was originally due to retire last October, on attaining the age of sixty-five years, but he was invited by the Board of Education to retain his post for a further year.

PROFESSOR HARRY E. CLIFFORD, since 1909 Gordon McKay professor of electrical engineering, has been made dean of the Harvard Engineering School, to succeed the late Hector J. Hughes, who died on March 1.

DR. M. T. TOWNSEND, associate professor of histology at the University of Oklahoma Medical School, has been appointed head of the department of biology at Illinois Wesleyan University, Bloomington.

DR. REGINALD D. MANWELL, of the School of Hygiene and Public Health of the Johns Hopkins University, has been appointed assistant professor of zoology at Syracuse University.

DR. CYRIL DARYLL FORDE has been appointed to succeed Professor H. J. Fleure in the chair of geography and anthropology at the University College of Wales, Aberystwyth.

DR. FIELDING H. GARRISON, now librarian of the William H. Welch Medical Library of the Johns Hopkins University, has been appointed resident lecturer in the history of medicine.

DR. BRADFORD WILLARD has resigned his position as assistant professor of geology at Brown University, to become associate geologist with the Topographic and Geological Survey of Pennsylvania.

DR. CHAS. M. A. STINE, chemical director of the E. I. du Pont de Nemours and Company, has been made vice-president and member of the executive committee. He is succeeded as chemical director by Dr. Elmer K. Bolton, who has been assistant chemical director under Dr. Stine.

DR. ARCHIBALD T. MCPHERSON, of Marceline, Missouri, has been appointed chief of the rubber section of the organic and fibrous materials division of the Bureau of Standards. Dr. McPherson will direct the section formerly headed by Mr. P. L. Wormelley, who has been called upon to take charge of the new section of specifications and testing. The change will become effective on July 1.

DR. HAROLD C. BRYANT, of Berkeley, California, has been appointed head of the new branch of education and research in the National Park Service. His official title will be assistant to the director and headquarters will be in the Washington office. Although his appointment will be effective on July 1, Dr. Bryant will not go to Washington until the fall, spending the intervening time in studying various natural history problems in the field.

Dr. J. H. Dellinger, chief of the radio section of the U. S. Bureau of Standards, was appointed official representative of the Institute of Radio Engineers at the seventh plenary meeting of the International Electrotechnical Commission in Copenhagen, Stockholm and Oslo, from June 27 to July 9. Dr. Dellinger sailed on June 17. It is hoped to hold the meeting of 1933 in the United States.

Dr. Eugene Pascu, of the University of Budapest, has been appointed assistant professor in the department of chemistry of Princeton University.

Dr. Frank Blair Hanson, professor of zoology in Washington University, is on leave of absence for the school year 1930–31. After July 1 he may be addressed care of The Rockefeller Foundation, Paris.

Dr. D. J. Healy, of the department of animal pathology at the University of Kentucky, has been granted a leave of absence for several months to go to Harvard University at the invitation of Dr. Roy Graham Hoskins, where he will be associated with Dr. Hoskins in work to develop technic in studying mineral metabolism and the functions of ductless glands.

Dr. Stanley D. Wilson, professor of chemistry and dean of the College of Science of Yenching University, Peiping, China, will spend the year 1930–31 in study and research chiefly at the University of Chicago.

At the Polytechnic Institute of Brooklyn, N. Y., Professor Vladimir Karapetoff, of Cornell University, and Dr. Ernst Weber, lecturer in the Technical School at Berlin, Charlottenburg, have been appointed visiting professors of electrical engineering. Dr. Weber takes the place of Dr. Bernard Hague, who returns to the University of Glasgow. Professor Clyde Whipple, assistant professor of electrical engineering, has been given a year's leave of absence to enable him to serve as visiting professor at Princeton University.

Dr. William H. Welch is visiting Pasadena, California, in order to make a study of the collection of books of the fifteenth, sixteenth and seventeenth centuries in the Harry E. Huntington Library.

Among foreign men of science who are expecting to visit the United States under the auspices of the International Institute of Education are Dr. Arthur Haas, professor of physics, and Dr. Eugen Oberhummer, professor of geography, both of the University of Vienna, and Dr. Basil M. Bensin, of the Agricultural Association of the Czechoslovak Republic.

Professor R. A. Morton, of the University of Liverpool, lectured at the Iowa State College from June 11 to 13. His lectures dealt with the study of absorption spectra and applications of this study to chemistry and to biological problems. Dr. Filippo Silvestri, director of the College of Agriculture at Portici, Italy, delivered a series of lectures on economic entomology from June 16 to 19.

Mr. C. F. Kettering, of the General Motors Corporation, Dayton, Ohio, has given to Antioch College $200,000 for the study of certain phases of photosynthesis. Dr. O. L. Inman will be in charge of the investigation, which is planned as a ten-year research project.

At the annual dinner of the faculty and alumni of Rush Medical College of the University of Chicago, on June 10, it was announced that Dr. Frank Billings, for many years professor of medicine and dean of the faculty, has given $100,000 to establish four fellowships at Rush Medical College. They are to be named in honor of Drs. Edwin R. Le Count, professor of pathology; Ernest E. Irons, dean and professor of medicine, and Wilber E. Post and Rollin T. Woodyatt, clinical professors of medicine.

Three fellowships in fisheries research have been provided at the University of Michigan by the Michigan Division of the Izaak Walton League of America, and two additional fellowships are offered by the Institute for Fisheries Research. These involve both field and laboratory studies on some practical fishery problem in Michigan. The stipend varies from six hundred to twelve hundred dollars.

Mr. and Mrs. Charles P. Hood, of Boston, have made a gift to the University of New Hampshire of $125,000 to be used at the discretion of the trustees.

An appropriation of $6,500,000 for the extension of the natural history building of the Smithsonian Institution would be authorized under the provisions of a bill (S. 3970), passed by the House on June 16. The bill would provide for additions to the east and west wings of the National Museum.

The cornerstone laying ceremonies of Ryder Hall, the new electrical engineering laboratory of Union College, Schenectady, took place on June 14 in connection with the one hundred and thirty-fourth commencement. Harold Russell Ryder, New York, donor of the building, laid the cornerstone. Dr. Edwin W. Rice, Jr., trustee of the college and honorary chairman of the directors of the General Electric Company, officially presented the building to the college, and it was accepted by President Frank Parker Day.

The forty-eighth annual meeting of the American Ornithologists' Union has been announced for the week beginning October 20, at the Peabody Museum at Salem, Massachusetts.

AT the last meeting of the College of Medicine of the University of Illinois Chapter of Sigma Xi, seven candidates for active membership and six candidates for associate membership were initiated. Dr. Lloyd Arnold presented his results on "An Experimental Study of Host Susceptibility to Vibrio Cholera Infections." For the ensuing year the following officers were elected: Dr. William F. Petersen, *president;* Dr. W. J. R. Camp, *vice-president;* Dr. William H. Welker, *secretary;* Dr. I. Pilot, *treasurer,* and Dr. Hugh A. McGuigan, *elective member of executive committee.*

AN appropriation of $50,000 to enable the Secretary of Agriculture to purchase a collection of moths and butterflies owned by the late Dr. William Barnes, of Decatur, Illinois, has been recommended by President Hoover. The collection, which consists of 473,000 specimens, would be housed in the National Museum.

THE American Engineering Council announces the appointment of a committee to cooperate in the publication of a new edition of "Who's Who in Engineering." The function of the committee, according to Mr. Lawrence W. Wallace, executive secretary of the council, is "to provide such advice on the qualifications of engineers as will enable the publishers to issue a work which shall be authoritative." The members of the committee are: R. F. Schuchardt, chief electrical engineer, Commonwealth Edison Company, Chicago; John S. Conway, Washington; Dr. Harry A. Curtis, Department of Chemical Engineering, Yale University; C. R. Dooley, Standard Oil Company, New York City; Colonel Frank M. Gunby, associate, Charles T. Main, Inc., Boston; Arthur Huntington, Iowa Railway and Light Corporation, Cedar Rapids, Iowa; B. A. Parks, Byron E. Parks and Son, Grand Rapids, Michigan; Dr. H. S. Person, managing director, Taylor Society, New York City; Dean A. A. Potter, School of Engineering, Purdue University, Lafayette, Indiana; George S. Rice, chief mining engineer, U. S. Bureau of Mines; F. F. Sharpless, consulting engineer, New York City; Robert Sibley, executive manager, California Alumni Association, University of California; Major Brehon B. Somervell, district engineer, U. S. Engineer Corps, Washington. The committee represents membership in the following societies: American Institute of Chemical Engineers, the American Institute of Electrical Engineers, the American Institute of Mining and Metallurgical Engineers, the American Society of Agricultural Engineers, the American Society of Civil Engineers, the American Society of Mechanical Engineers, the Grand Rapids Engineers Club, the Society of American Military Engineers, the Society of Industrial Engineers and the Taylor Society.

DISCUSSION

THE QUESTION OF THE CENTRAL BODIES

IT has been suggested of late that the so-called central bodies (centrosomes, centrioles) long ago made known by Flemming, Van Beneden and Boveri, and later studied by many other expert cytologists, have no objective existence in the living cell—that they are, in fact, either coagulation-artifacts or the offspring of an unholy union between random granules in the cell and an over-developed will to believe on the part of the observer. Could this be substantiated, it would constitute an important discovery—psychological as well as cytological—and assuredly the questions thus raised should have every opportunity for critical test. In the meantime, I will briefly indicate some of the grounds for thinking that the central bodies may for the present maintain a modest footing in respectable biological society.

Two of the classical objects that have played a leading part in the development of our knowledge in this field are the germ-cells of the nematode *Ascaris megalocephala* and of the annelid *Chaetopterus,* the former having long ago provided the material for the pioneer researches of Van Beneden, Boveri and Brauer, the latter for the important later work of Mead. Both these cases are now in course of reexamination in the Columbia Laboratory. The work of H. P. Sturdivant, dealing especially with the sperm-forming divisions in *Ascaris,* and later to be reported by him in detail, has produced decisive confirmation of the most essential results concerning the central bodies made known by Boveri, O. Hertwig and Brauer. The case of *Chaetopterus,* including the history of the central bodies in maturation, fertilization and cleavage, is being reviewed by the writer in a study of Mead's original preparations and drawings, a large number of which have generously been placed in my hands for the purpose. Many of these preparations, as might be expected after thirty-four years, are now badly faded, though they show good promise of successful restaining. Fortunately, however, a sufficient number have retained their original brilliancy to make possible a close study, with the best modern optical apparatus, of all the essential phenomena recorded by Mead in 1898; and in a number of cases a thorough examination could be

made of the same individual sections, some of them still of great beauty, from which the original figures were drawn.

It is a pleasure to bear witness to the fine quality of these admirable preparations, to the exceptional precision with which they were described and figured and to the faithfulness of Werner and Winter's lithographic reproductions of the original drawings. The figures do not exaggerate the clearness of the preparations; they are not schematized; they represent accurately the facts as they were seen and in large measure may still be seen. No critical observer, I think, who closely studies these preparations could take seriously the naïve notion that the centrioles are merely random granules that happen to lie at or near the astral centers. The assumption that they are merely the coagulated central portions of the astral rays deserves more respectful consideration, but this too seems to me inadmissible in view of the fact that both in maturation and cleavage the centriole is double from the metaphase onwards, and that during the anaphases its halves are more or less widely separated at a time when the asters show no sign of duality, before they have begun to elongate at right angles to the spindle-axis and before the small daughter-asters of the telophase have appeared. Similar conditions are seen with equal clearness in the *Ascaris* spermatocytes, and in great numbers of cells.

In respect to the genetic relations of the central bodies, it must be plain to every observer that in these objects some kind of genetic continuity is maintained between the astral systems of successive divisions. From the first appearance of the polar asters in *Chaetopterus* down to their disappearance after the second polar division, and then again from the first appearance of the sperm-aster through all the operations of fertilization and the earlier cleavages, the new asters arise at each step within, or in close proximity to, the preceding ones. All points to the conclusion that, in these divisions at least, this relation is determined by the centrioles, which are handed on bodily from cell to cell and act as centers for the formation of new asters in each succeeding generation. In respect to all this, and much more, the *Chaetopterus* preparations show a remarkably close and detailed resemblance to the conditions figured and described by Coe in *Cerebratulus* and by Griffin in *Thalassema,* and they are in substantial agreement with the results of many other accurate observers of the same period, including Boveri, Meves, Heidenhain, Ballowitz, Kostanecki, MacFarland, Vejdovsky and others who contributed to the development of the classical view.

For the foregoing reasons I am convinced of the objective existence of the central bodies as normal components of the cell (I do not say of all cells) and of the correctness in principle of the conclusions concerning them drawn by Mead and his fellow workers in this field. Doubts concerning the centrioles have sometimes been caused by considerations relating to the technique of staining. It was long ago demonstrated by Boveri (1901) that so long as the centriole remains single its existence within the centrosome or aster is not susceptible of rigorous demonstration by the regressive methods of staining in iron-hematoxylin, for the apparent size of the centriole may be varied at will, down to seeming disappearance, by extracting the dye in successive degrees. But at certain stages, as above indicated, two centrioles are regularly found at a time when the centrosome or aster is still single—a condition explicable neither as a product of centripetal or concentric extraction (as Boveri also pointed out) nor of mere coagulation of the rays. As a third possibility, the centriole might be thought of as no more than a focus of centripetal condensation within the aster, having no sharply marked boundaries, yet capable of division as if it were an individualized body, and offering the aspect of such a body after centripetal extraction. Such a notion is hardly different in principle from the classical conception, but it introduces new and perhaps insurmountable difficulties, particularly in view of the fact (apparently well established) that in some cases the centriole may persist, as a double structure, in the absence of asters, during the whole interkinetic phase of the cell.

EDMUND B. WILSON

COLUMBIA UNIVERSITY

CREDIT OR RESPONSIBILITY IN SCIENTIFIC PUBLICATION

MAY I venture a comment bearing on the question of credit for illustrations in connection with recent letters by Dr. Stiles and Dr. Mueller? Every one must acknowledge the justice of the criticisms made by both writers, but in neither case is there any practical method of securing real justice. Most illustrations of value enough to be frequently copied are the result of the combined effort of quite a number of individuals. A restoration of an extinct animal owes much of its value to the artist who drew it and likewise to the scientist who deduced from its skeleton the resemblances to and differences from existing animals that must serve the artist as his guide, who in many cases provided the artist with sketches or rough drawings to finish for publication. But no less it is the work of the skilled preparator who, guided by expert practical knowledge of osteology,

has spent months of labor in piecing and articulating the skeleton; and to the equally skilled field man who spent months in the bad-lands searching for it, and when found knew how to bring it all in in such condition that it could be reconstructed by the preparator. Who is to decide what meed of credit belongs in each instance to each man? And how about the great foundation or the generous donor whose money has paid for all this work? Most important contributions to science nowadays are composite work, of which the author's contribution is often only a minor part. Yet we continue to apply to them standards of professional ethics derived from a time when most research contributions were from start to finish the work of the author, usually on his spare time; and any minor aid from others was acknowledged.

All this discussion of credit omits the really important and essential reason why an author's name is attached to a published contribution or illustration. He is the party responsible for the statements, results and conclusions therein. That is the point with which the reader of the article is chiefly concerned. Scientific publications are printed and distributed primarily for the benefit of the reader, not to enhance the reputation of the writer. We are all apt to forget that, being all egoists in varying degree, but it is nevertheless true and should be kept in mind in discussing professional ethics. What concerns me when I am reading a scientific paper is how far I should accept its statements and conclusions, whose authority lies back of its illustrations—who is responsible. I don't care who made the drawings, so that they are certified as accurate by a reliable authority. Nor do I care who collected or prepared the specimens, so that my authority is responsible for stratigraphic and collecting data and reconstruction. As a side issue and a matter of personal acquaintance with the men concerned, these points may be of interest. But my prime concern is to get hold of as much authoritative, well-expressed information as possible in the field covered, and to size up just how far I can trust in its accuracy and thoroughness.

This I take it is the practical reason why an article or illustration in a scientific journal should be, as it usually is, credited to author A, even though most of the work was done by assistants B and C, artist D, preparator E and collectors F, G and so on. In an art magazine the artist would naturally be cited as author of the illustrations, as the reader would care very little about the scientific soundness. In a popular book or magazine they would usually be credited to the collaborator who had the biggest newspaper reputation. The late Mr. Carnegie is presenting a Diplodocus to Mexico. That is the aspect of the transaction that interests the public. But the Mexican scientist who studies that reconstruction regards Dr. Holland as his authority for its accuracy. I see no more reason why Professor Berry in copying a restoration of *Diatryma* should credit it to the artist instead of the authors than for the text-book in which it appears to be called McGraw-Hill's "Paleontology" instead of Berry's.

As to the "customary acknowledgments" in a scientific article, they may relieve the conscience of the author, but does any one really suppose that a line or two in the introduction which nobody reads does justice to the part played by a collaborator who often has contributed much more work than the author and sometimes more brains? His real profit lies in the fact that he has got his work and his ideas on record, accessible to all who are interested. That is what we all profess to be working for in scientific research. If personal credit is all that concerns us, let us drop the hypocrisy of pretending otherwise, or claiming that the world owes any special recognition or reward to our "unselfish efforts."

W. D. MATTHEW

UNIVERSITY OF CALIFORNIA

GENETICS

I HAVE just received the third edition of Walter's "Genetics," of which it may be said that it is well written, comprehensive and essentially up to date. But it seems to me to start out with an extraordinary confusion of ideas. A diagram represents "the triangle of life," the three sides being heritage, environment and response. It is said that when this idea is applied to man, "there are theoretically at least a minimum of twenty-seven possible kinds of human beings, as shown in Fig. 2." Fig. 2 shows "The scale of success. A stands for high grade; M for mediocrity; Z for low grade." These grades are assumed to exist in respect to each side of the triangle, and to vary independently. Thus No. 4 has first-class heredity and environment, but exhibits Z response or conduct. No. 25 has Z heredity and environment but A conduct. Now it is certainly true that the springs of human personality are far too subtle to be completely "explained" in scientific terms, but from any point of view, the exhibit in Fig. 2 is contrary to reason and experience. Further confusion of ideas is shown in the definition: "Response, on the other hand, represents what the individual *does* with his heritage and environment. It is what may be described as the training or educational factor, most clearly demonstrable in the higher animal forms."

The book also reminds us of a serious dilemma which confronts teachers of genetics, or indeed of scientific subjects in general. The subject-matter has

grown enormously in recent times, and when the resulting complexities are presented in a text-book, the necessary consequence is that more and more this takes on the form of an encyclopedia or dictionary. Yet it can not be said that any of the items are unimportant. It seems to me that from a pedagogical standpoint we shall be compelled, in beginning courses, to eliminate many of the topics, and treat the rest more fully and interestingly. By so doing we may create an enthusiasm for the subject and produce a far more permanent impression than is derived from a multitude of half-understood facts memorized for the examination.

T. D. A. COCKERELL

UNIVERSITY OF COLORADO

MALFORMED LEG BONES IN YOUNG CHICKENS

A CONDITION in young growing chickens referred to by different ones as leg weakness, rickets, enlarged hock joints, slipped tendons and malformed leg bones has become serious in many sections of the country. The condition is aggravated by intensive methods of production such as confinement in small runways and storage brooders where exercise is limited.

This deformity differs from rickets since it develops in the presence of vitamin D and a well-balanced mineral mixture. Between the ages of three and six weeks the hock becomes enlarged, probably on account of edema and slight hemorrhages usually found in the tissue surrounding the joints. The gastrocnemius or main tendon which extends the foot and flexes the leg occasionally slips from the condiles which hold it in place. This may be responsible for the stiffening and malposition of the leg below the hock joint as found in advanced cases. Either or both the femur and tibia may become enlarged or develop marked curvature and one or both legs may be involved. The legs may bow out, curve in or take on other unusual shapes.

The number of chicks affected in a flock has been observed to vary from 1 to 60 per cent. The trouble has not been confined to any group of conditions. It may be found in both slow and rapidly growing chicks, with all-mash or with grain and mash rations, on wire and board bottom runways and with high and low mineral content in the rations.

The departments of poultry husbandry, chemistry and pathology at the Kansas Agricultural Experiment Station are now working together in a cooperative experiment to find if possible the cause of this trouble.

LOYAL F. PAYNE

KANSAS STATE AGRICULTURAL COLLEGE

QUOTATIONS

ELMER A. SPERRY

"THE lot of every one of us," wrote Horace, "is tossing about in the urn, destined sooner or later to come forth and place us in Charon's boat for everlasting exile." This time the lot has come forth for one whose going the whole planet will regret. A passenger on the high seas, remembering the fate of Palinurus, wrote of this great inventor whose mechanical helmsman, called familiarly the "Metal Mike," now guides great ships to their desired havens:

> Now is old Palinurus' occupation gone;
> It has been taken o'er by one named Sperry
> Who has installed a "Metal Mike" instead—
> He'll soon be putting one on Charon's ferry.

Unhappily for us who still remain this side the River of Woe, Mr. Sperry has gone to his "aeturnum exsilium," but he has left among men an everlasting fame, and imagination allows one to think of his inventive spirit making suggestions to the ferryman about improving service in the crossing for the benefit of those who have to take it later. For Mr. Sperry was ever thinking of how he might make the dwellers on earth a little more at ease whether on sea or land or in the air. For those who travel by sea he provided not only the pilot, who whatever betides holds his rudder true, but also a "stabilizer" to prevent the rolling of the ship and a device for signaling to prevent collisions. For those who travel by air he has helped to maintain the equilibrium of their planes and to lessen the peril of fire and to penetrate the fog. Towards the end of his long series of inventions he perfected an instrument for detecting the slightest imperfection in a steel rail.

What his born genius for invention would have done for a slower-going civilization one cannot imagine, so closely has it been associated with the swifter agents of this mobile age. He would have been put among the Titans in the ancient Greek age. But with all his seemingly miraculous achievements, he who harnessed the motion of the earth to do his bidding was a gentle human being, generous in his sympathies and beloved in his own person. America, claiming him for her own and proud of his contributions, which were recognized by the highest honor bestowed by his own profession in his own country, remembers with special satisfaction that he was acclaimed by his fellow-engineers of the world, when he presided at the International Congress of Electrical Engineers in Japan last year.—*The New York Times.*

SCIENTIFIC BOOKS

Lehrbuch der Protozoenkunde, eine Darstellung der Naturgeschichte der Protozoen mit besonderer Berücksichtigung der parasitischen und pathogenen Formen. Begründet von FRANZ DOFLEIN, neubearbeitet von EDUARD REICHENOW. Ed. 5, Jena, Verlag von Gustav Fischer. vi + iv + vii + 1262 pp., 1201 figs. in text. 1927–1929. Price, bound, 70 marks.

AMONG the many German text-books of specialized nature issued by the well-known publishing house of Gustav Fischer, few, if any, have had the cordial reception which has been accorded to Doflein's "Textbook of Protozoology," and none has had a wider usefulness. This has been in part due to the key position which the Protozoa hold in the field of biology. They are first in the evolutionary series of animal forms, and have intimate relationship with the plant series. They present extraordinary diversifications in structure and life history; their ecological adaptations bring them into the most diversified environments; their cytological developments surpass those of all other cells in the complexities and modifications which have emerged in the long period of their evolution; it is probable that the number of species now living will be found to exceed that of all other animals, the insects included, and their interrelations in the web of life link them in intricate chains of food relations, soil conditions, oceanic deposits, commensalism, symbiosis and disease. Scarcely an animal or plant exists that is not in one or many ways entangled in this web with the Protozoa.

The merit of the series of editions of Doflein's textbook lies in the fact that he grasped the wide significance of the relationships of the Protozoa, advanced each successful edition in the forefront of this rapidly progressing science, and was never provincial in his grasp of his field or in its presentation.

In addition to these qualifications he organized his material logically, developed it symmetrically and presented it with lucidity and forcefulness. He had a keen scent for the significant organisms or features of structure—a fact revealed in the selection of subjects for his own contributions to protozoology. Protozoologists and biologists generally have come to await with eagerness the next edition of Doflein in order that they might catch up with the broader aspects of the subject. Although he always presented the parasites and pathogenic aspects of the Protozoa, he never subordinated their broader biological phases to these more practical or immediately useful subjects, as has been notably done in Wenyon's recent "Protozoology."

Another feature of Doflein's authorship which is distinctive and for which the publishing house of Fischer is also to be congratulated is the high standard of artistic and technical skill in the illustrations. New and original illustrations were often prepared, figures from other investigators never suffered at his hands and a wealth of carefully selected figures adorns nearly every page of the large volume.

The new edition prepared by Dr. Eduard Reichenow, professor and director of the protozoological division of the widely known Hamburg School of Tropical Medicine, follows in the main very successfully along the lines of the earlier editions. Changes involved are the entire omission of the Spirochaetes, which, quite properly, are now relegated to the Bacteria. New illustrations, many of them original from Doflein, to the number of several hundred, have been introduced; the formerly separated sections on morphology and on physiology are quite significantly combined in one.

More than ten years have elapsed since the fourth edition was published. The great volume of new material which has been published in the intervening years has compelled a rewriting of almost the entire text, which, together with the vast array of material to be reviewed, is no small undertaking. This fact is doubtless responsible for the relatively larger use made of German sources in this revision as compared with the earlier ones.

This is hardly the place for a critical survey of the details of the new edition, but only for a brief characterization. The text, in comparison with the best edition, is in a somewhat more involved style; there is a relatively greater proportion of German work in the new bibliographic citations, and there is a considerably fuller presentation of the parasitic genera and species, which will doubtless meet with approval of many users of this monumental work.

The reviser is to be congratulated on the high order of scientific service rendered in the preparation of this summary of a field so wide, so diverse and so widely useful. The publisher has also given the book the fitting set-up which biologists the world over have long associated with his imprint.

CHARLES A. KOFOID
DEPARTMENT OF ZOOLOGY
UNIVERSITY OF CALIFORNIA

Der Hochgebirgssee der Alpen. By OTTO PESTA. Bd. VIII of Thienemann's Binnengewässer, 1929, 156 pp., 8 pls., 41 figs. Published by E. Schweizerbart'sche Verlagsbuchhandlung, Stuttgart.

THE author restricts the term "high mountain lakes of the Alps" to those bodies of water that are situated above the timber line, which lies at 1,800 to 2,000 meters above sea-level in this region. These elevated

bodies of water range from mere tarns up to 148 hectares in area; only two of them exceed 100 hectares, while five exceed 50 hectares. The shores usually consist of gravel and boulders.

One lake is 102 meters deep and 28 are more than 30 meters deep; most of them range from 1.8 meters to 30 meters in depth. Some of the lakes are fed by glacial waters and the detritus therein gives the lake water a milky appearance. A few have dark-colored water, but most of them are green or blue-green to blue in color.

The summers are short but rather warm at this altitude; in the deeper lakes the temperature of the surface water ranges from 10° to 14°, or even 20° C. in summer, while the bottom temperatures are 3.8° to 5.6° C. In some of the more elevated lakes the surface temperature is as low as 1.5° to 4° in August. As a result of the severe climatic conditions at this altitude the various bodies of water are covered with ice from 150 to 270 days each year; a few of them may be frozen for 300 days or even the entire year at certain times. The thickness of the ice varies from 49 to 87 centimeters.

The waters of these lakes hold a relatively small amount of salts in solution so that the dry residue is small, ranging from 0.4 to 30 milligrams per liter. In general, calcium is the chief mineral constituent. The water contains an abundance of dissolved oxygen, but the amount is below the saturation-point in all cases.

Very few large aquatic plants are found in these lakes because the growing season is short and the temperature is low; also the bottom is unfavorable for attached plants because it consists of gravel and boulders. Several of the green algae, such as Spirogyra, Zygnema, etc., are found more or less abundantly in some of the lakes. The low temperature of the water and the small amount of salts are unfavorable factors for the phytoplankton; diatoms seem to withstand these conditions much better than the green algae. Peridinians and flagellates are found to a limited extent in the summer.

Animal forms are represented by amphibians, fishes, mollusks, insects, crustacea, rotifers, worms and protozoa. The biology, ecology and origin of the fauna are discussed at some length. The bibliography contains a list of 142 titles.

CHANCEY JUDAY

WISCONSIN GEOLOGICAL AND NATURAL HISTORY SURVEY

Antarctic Adventure and Research. By GRIFFITH TAYLOR. Appleton (New World of Science Series), 1930. 245 pp., 34 figs. $2.00.

THE appearance of this little book from the pen of Captain Scott's senior geologist on his last expedition, now holding the chair of geography at the University of Chicago, is most opportune when so many are stimulated to inquiry into Antarctic conditions. It might well be doubted if there is any one to-day better fitted to treat of this broad subject. Professor Taylor's background is well displayed in his summary of Antarctic exploration which occupies the first eighty-two pages of the book. The *raison d'être* of each expedition, the importance which it assumes and the results which were achieved are all treated with a thorough grasp of the subject and with a brevity which is masterly. The delicate international questions which have sometimes been involved are dealt with fully and fairly.

The remaining chapters of the book are devoted to "The Continent, its Geology and Relation to Other Lands," "Scenery and Topography," "Ice-sheets and Glaciers," "Oceanography and Sea Ice," "Climatology," "Flora and Fauna" and "Commercial and Political Aspects." The more important reference works for each chapter are cited and evaluated, and the book has a good index. The thirty-four text illustrations, though a little crude and sketchy in character, are none the less very helpful in the exposition of the subject. A surprising amount of accurate and well-arranged scientific material has been compressed into this little book, though the interest is kept up to the end. It is to-day the best book on the subject which it treats.

WM. H. HOBBS

UNIVERSITY OF MICHIGAN

SCIENTIFIC APPARATUS AND LABORATORY METHODS

AN IMPROVED COLOR STANDARD FOR THE COLORIMETRIC DETERMINATION OF CHLOROPHYLL[1]

A RAPID and accurate method of measuring quantities of chlorophyll in plant extracts reported previously[2] included the use of an appropriate color standard and a colorimeter. The color standard was prepared by mixing stock solutions of the dyes, Malachite Green and Naphthol Yellow, in such proportions that the tint was practically identical with that of solutions of saponified chlorophyll. Evaluation of the color standard in terms of known concentrations of chlorophyll made it possible to determine the chlorophyll content of certain strains of corn in a convenient manner.[3] The procedure outlined offers

[1] Paper of the Journal Series, New Jersey Agricultural Experiment Station, Department of Agronomy.

[2] Howard B. Sprague, "A Convenient Method of Measuring Quantities of Chloroplast Pigments," SCIENCE, 67: 167–169, 1928.

[3] Howard B. Sprague and J. W. Shive, "A Study of the Relations between Chloroplast Pigments and Dry Weight of Tops in Dent Corn," *Plant Physiology*, 4: 165–192, 1929.

a new approach to the important problem of determining the relation between quantities of chloroplast pigments and plant growth.

In making use of the method for studies concerning the nutritive value and chlorophyll content of plant tissue, the second author of this note found it desirable to modify the color standard by changing the relative proportions of the two dyes. The modified color standard is more satisfactory for general work than the one described previously, since it produces a more perfect match in color with chlorophyll extracts of various plants. It is prepared as follows.

Nine tenths cc of a ½ per cent. aqueous solution of Malachite Green and 11.2 cc of a ½ per cent. aqueous solution of Naphthol Yellow are made up to 5,500 cc with distilled water. The concentration of color in this standard is the equivalent of that produced by 11.873 milligrams of chlorophyll saponified to chlorophyllins and diluted with water to make one liter.

Several investigators have called attention (in personal correspondence) to the variability in different lots of Malachite Green and Naphthol Yellow which may be purchased. Because of this situation, lots of dyes from a number of sources have been compared with the original dyes[3] used in preparing the standard. The following lots of Malachite Green were apparently identical with the original lot: (1) *Malachite Green Crystals,* 1264, Research Laboratory, Eastman Kodak Company; (2) *Malachite Green Crystals,* the Coleman and Bell Company; (3) *Malachite Green,* for histological use, Schultz No. 495, C. I. 657, National Aniline and Chemical Company, "Found satisfactory by commission on standardization of biological stains for above-mentioned purposes."

Malachite Green 0926, Dr. Grübler and Company, Leipzig, Germany, was identical in color but more concentrated than the original lot of dye. *Malachite Green Hydrochloride,* the Coleman and Bell Company, proved unsuitable for this purpose.

The several lots of Naphthol Yellow tested were identical in tint with the standard lot of this dye, but all required filtering except the Martiusgelb of Grübler. One half per cent. aqueous solutions of each lot of dye tested were made with distilled water and allowed to stand for several hours until maximum solution at room temperature was obtained, and then filtered with No. 42 Whatman filter-paper. With this treatment, the following lots of dye gave filtrates identical in color and concentration with the standard lot of Naphthol Yellow: (1) *Naphthol Yellow S,* National Medicinal Products, National Aniline and Chemical Company; (2) the same label as No. 1 but distributed by the Eastman Kodak Company; (3) *Naphthol Yellow,* E & A Biological Stains, B 119, Eimer and Amend.

The *Martiusgelb* of the Dr. Grübler and Company proved less concentrated than the original dye, likewise the *Martius Yellow* (Naphthol Yellow) Schultz No. 6, C. I. 9 of the National Aniline and Chemical Company. The latter dye bears the additional statement, "Found satisfactory by commission on standardization of biological stains, for use in histology, especially the Pianese triple stain." The *Naphthol Yellow* sold by the Fisher Scientific Company was more concentrated than the original standard dye.

It is suggested that workers expecting to make use of the chlorophyll color standard described in the foregoing in any extensive investigations purchase a considerable quantity of the satisfactory lots of dye.

HOWARD B. SPRAGUE
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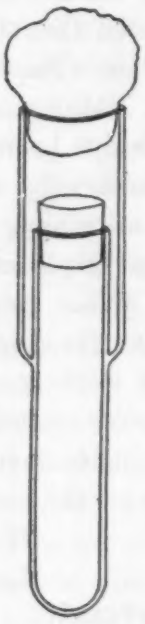
A STORAGE TUBE FOR PLASMA AND EMBRYO JUICE

IN cultivating mammalian tissues *in vitro* the problem of containers for the storage of embryo juice and plasma is often a vexing one since it is difficult to insure effective cooling and sterility and at the same time to facilitate the handling of these substances. In our laboratory we have devised a double-necked tube which has proved very efficient and which may be of interest to others engaged in similar problems, as it avoids these difficulties. The single tube in common use is very subject to infection in the ice pack, and the constant flaming besides being a nuisance hastens clotting. The double tube described by Strangeways, while insuring sterility, is difficult to cool and in operation has the same objections as the single tube. To overcome these difficulties we prepared a tube with a double neck fashioned in such a manner that the outer neck was somewhat longer than the inner one in order that each could be plugged independently. The lower end of the tube being of a single thickness is in direct contact with the ice and insures cooling. The opening of the outer neck is plugged with cotton which may be removed by the fingers. The inner neck-opening is plugged with a sterile cork and can be removed with sterile forceps. This double protection has many advantages that facilitate operation.

Used in place of the usual tube in centrifuging the rat plasma, the double plug insures sterility without flaming and removes the risk of raising the temperature and hastening clotting.

In the operation of mounting the cultures the containers for the embryo juice and the plasma must be opened many times. This operation necessitates flam-

ing each time to avoid infection and is time consuming. Used in this operation the double-necked tube



is supported in the ice pack at an angle of 45°. When the inner plug has once been removed it is left out, the outer cotton plug alone being used. This may freely be removed and replaced many times without flaming. The tube can thus be used throughout the operation (in our case thirty cultures) without removal from the ice pack, with much saving of time and no danger of infection. Even in experiments where heparin is used to prevent clotting and the ice pack dispensed with the double-necked tube saves much time and is an additional precaution against contamination.

As will be seen from the diagram this tube consists of a small test-tube 7½ cms in length, 1½ cms in diameter and rounded off at one end. A collar is fused to this tube about 2 cms from the open end. It projects 3 cms beyond the open end of the inner tube. The jacket has a total length of 5 cms and a diameter of 2 cms.

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SPECIAL ARTICLES

VITAMIN B_2

WHEREAS considerable progress has been made on the concentration of vitamin B_1, comparatively little work has been reported on the purification and concentration of vitamin B_2. Within the last year only two communications, one by Chick and Roscoe,[1] and the other by Narayanan and Drummond,[2] have appeared on this subject. In the first paper a partial separation of the B_2 fraction from B_1 is reported. The process leading to the separation was very complicated, involving many steps. In the second paper, which has appeared very recently, vitamin B_2 is active in daily doses of 0.006 gm.

Over a year ago, we succeeded in separating the B_2 fraction from B_1 in a very simple way. Itself added to a vitamin B-free diet, it did not maintain growth of white rats; with 0.00015 to 0.0002 gm of our vitamin B_1 fraction, it maintained normal growth.

Fraction B_1 is adsorbed on silica gel at pH 3. The filtrate is rich in vitamin B_2, but still contains some vitamin B_1. By precipitation with acetone a material is obtained of which daily doses of 0.015 gm in addition to 0.0002 gm of B_1, both added to the standard diet, suffice to maintain normal growth of white rats. By repeating the extraction six times, a material is obtained from the filtrate of which daily doses of 0.005 gm are required. Finally, when this material is dissolved in water and precipitated with alcohol containing one per cent. of hydroiodic acid, a material is obtained of which daily doses of 0.0007 gm suffice to maintain normal growth of white rats.

P. A. LEVENE
THE ROCKEFELLER INSTITUTE FOR MEDICAL RESEARCH

[1] Chick, H., and Roscoe, M. H., *Biochem. J.*, 23: 504 (1929).

[2] Narayanan, B. T., and Drummond, J. C., *Biochem. J.*, 24: 19 (1930).

THE BEHAVIOR OF WINTER WHEAT IN ARTIFICIAL ENVIRONMENTS

IN physiological investigations of diseased as well as healthy winter wheat plants, frequently it has not been possible to obtain satisfactory results with the plants produced in greenhouses and experimental culture chambers. Such plants produce abnormally long leaves and leaf sheaths, and tillering tends to be reduced during the early growth stage (predormant stage) previous to the stage of winter dormancy as compared with plants grown in the open. These abnormalities have made it practically impossible to study the rosette phase of the wheat-mosaic disease under controlled conditions throughout the year, and to obtain satisfactory heading in winter varieties.

In 1925, studies were started with the definite aim of determining methods for obtaining normal winter wheat, especially during the predormant growth stage in experimental culture chambers.

As a basis for determining normal development, measurements were made on field-grown Harvest

Queen winter wheat plants at the end of the autumn growth period. The mean length of the longest leaves and longest leaf-sheaths on each tiller and the number of tillers on each plant are satisfactory standards of comparison. The average length of the longest combined leaf and leaf-sheath and the average number of tillers are equally satisfactory in most work. The present standard plant has, when planted an inch apart in the drill row, 5.5 tillers; the longest combined leaf and sheath is 16 cm long, and the plants are recumbent. Plant development is affected by season and soil conditions, but the standard given is the average for plants at the end of an autumn favorable for winter wheat.

Plants grown under glass at all the temperatures studied produced longer leaves and leaf-sheaths and fewer tillers than plants grown simultaneously at the same temperature, but not under glass. These abnormalities have been greatest, however, at high temperatures and during the long days of summer. Several commercial glasses having higher transmitting qualities for the ultra-violet than ordinary glass and also some of the nitrocellulose and cellulose-acetate products in clear sheet form and in screen wire form were tested for their effect on normal plant development. One product, a Corex glass (G 980 A), showed some advantage over common glass, but this advantage was not great.

Daylight was supplemented by artificial light from Mazda lamps, the Cooper Hewitt mercury vapor work lamp and the Hanovia Luxor Model Quartz mercury-arc-lamp, but the additional light from these sources failed to overcome the influence of glass on the plants. The tests did indicate, however, that the Cooper Hewitt mercury vapor work lamp, which produces a yellow, green, blue and violet spectrum, caused less elongation of foliage and less reduction in tillering than the Mazda lamp.

In studies on the design of plant culture chambers it was found that wheat grown near 59° F. in the winter approximated the normal more closely than plants grown near the same temperature in midsummer. This suggested that the length of the day influenced the elongation of leaves and sheaths and tiller production, and that a short day would compensate to some extent for the difficulties introduced by glass. Harvest Queen wheat plants grown near 59° F. and with the day shortened to seven or eight hours averaged five tillers each, with the longest sheath and leaf averaging 15 cm in length. The plants were slightly more recumbent than is usual for this variety in the field. In other respects the plants were morphologically normal in comparison with field-grown plants entering the period of complete dormancy.

These studies have been extended to include the later stages of development of Harvest Queen winter wheat and Purple Straw, a variety which has been classed as a winter type and also as a spring type. One experiment, started February 6, 1930, is cited.

During the first 28 days of growth the plants were in an experimental chamber held near 59° F. The following 32 days the temperatures followed a daily undulating curve having a minimum near 40° F. at 2 A. M. and a maximum near 59° F. at 2 P. M.

One half of the series received the full sunlight and in addition sufficient light from a Mazda electric lamp to produce a day approximating 16 to 17 hours; the other half of the experiment received sunlight for seven to eight hours daily. At the end of this 60-day period all the plants were removed from the chamber, placed in a small greenhouse and given approximately 17 to 18 hours of sunlight and electric light daily at a temperature ranging around a mean approximating 70° F.

The Purple Straw plants headed earliest (85 days after planting) when given a long day in their early stages, whereas the Harvest Queen plants headed quickest (92 days) when given the short day during their early stages.

The Purple Straw plants given the short day headed in 92 days. The Harvest Queen plants given the long day started to head in 97 days, but the heading of the culms was very irregular as contrasted with the rest of the series, and the plants tillered excessively.

Other tests conducted in 1928 and 1929 also show conclusively that, when plants are held at 40° F. or above during early growth, exposure to 16 to 18 hours of light daily retards heading and stimulates excessive tillering in Harvest Queen. However, this length of day hastens the heading process and does not stimulate excessive tillering in this variety if the small seedlings (plumules ¼ to ½ inch long), or seeds which show the first stages of germination activity, are first subjected to 31 to 33° F. in a mechanical refrigerator for a suitable period before planting at the growing temperatures. These results indicate that early heading in winter wheat is influenced both by low temperatures and by short days during the early stages of development, either of these environmental factors operating singly at optimum compensating to some extent for excess of the other.

Our results show distinct advantages when conducting experiments under conditions approximating the seasonal fall and rise in temperature and day length. However, it is possible by properly combining day length and temperature greatly to hasten the heading process in chambers as compared with that in the

field. We have obtained mature seed from winter wheat 100 days after planting by growing the plants in an 8-hour day and at 50° and 60° F. during the first 54 days of growth, followed by days ranging from 17½ to 18½ hours in length and temperatures fluctuating above and below 70° F. On this basis two, and under ideal conditions, three successive crops may be grown in 12 months. This is a distinct advantage in connection with genetic, physiological and pathological studies. Conditions favoring early heading and maturity, however, do not necessarily favor high yields of grain.

The plant culture chambers in which the tests were conducted were glazed with Libbey Owens flat-drawn single strength window glass. The chambers were located out of doors. They will be described more fully in another paper.

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THE CYTOLOGY OF CILIA FORMATION IN THE SWARM-SPORES OF MYXOMYCETES

THE swarm-spores of the myxomycetes have been studied in some detail by Jahn.[1] In this study the cilium is shown to develop directly from the centrosome. Wilson and Cadman[2] have referred to this body as the centroblepharoplast. During the mitosis immediately preceding the formation of swarm-spores, the poles of the spindle are occupied by centrosomes which give rise directly to the cilia of the resulting swarm-spores. As pointed out by Jahn, the time is very brief between the initiation of cilia-formation during the last phases of the division of the mother cell and the development of the cilium of each daughter cell. It is then apparent that, in order to be able to kill and fix favorable material for the study of all stages in this very rapid process of cilia-formation, it is necessary to be able to control accurately the stimuli which initiate this process and the conditions which make its completion possible. When this is accomplished, one may kill spores and prepare them for study at any stage of development desired. The methods which the writer[3] has used in his studies of the zoospores of various species of the lower fungi have been found to be applicable to the study of the swarm-spores of the myxomycetes.

In the study of *Reticularia lycoperdon* Bull. the writer has found that the cilia-forming organ in the swarm-spore is composed of several granules, instead of a single centrosome granule as described by Jahn. The basal apparatus is similar in many respects to those of the uniciliate spores of the species of Blastocladia and of Allomyces described by the writer (*loc. cit.*). There are, however, several very significant differences. The first phase when the basal granule or granules, as the case may be, tend to migrate away from the nucleus or its pole seems to take place more rapidly in the case of the developing cilium of *Reticularia lycoperdon* than in the uniciliate spores of species of Blastocladia and Allomyces. As the cilium matures these granules migrate back toward the nucleus in both cases, but in the case of the myxomycete swarm-spore they move quickly and completely back to the pole of the nucleus. In the uniciliate spores of the species of fungi studied the basal granule (blepharoplast) usually remains at the base of the cilium. This complex of granules, which appears as a single large granule at the base of the cilium of the mature myxomycete swarm-spore, is then of considerably more importance than a simple centrosome in the sense of Jahn's description. This structure may even be comparable to the entire basal apparatus of the uniciliate spores of species of Blastocladia and Allomyces.

A more detailed account of the physiology and cytology of the active stages of the swarm-spores of this and several other species of Myxomycetes will appear in a botanical periodical at an early date.

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1 "Kerntielung und Geisselbildung bei den Schwärmern von *Stemomtis flaccida* Lister," *Ber. Deutsch. Bot. Gesellsch.*, 22: 84–92, 1904.

2 M. Wilson and E. G. Cadman. "The Life History and Cytology of *Reticularia lycoperdon* Bull.," *Trans. Roy. Soc. Edinburgh*, 55: 555–608, 1928.

3 "A Cytological Study of the Zoospores of the Genus Blastocladia," *Bot. Gaz.* (in press); "The Development of the Zoospores in the Oomycetes and the Cytology of their Active Stages," *Am. Jour. Bot.* (in press).

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WIEMAN, H. L. *An Introduction to Vertebrate Embryology.* Pp. xi + 411. 201 figures. McGraw-Hill. $4.00.

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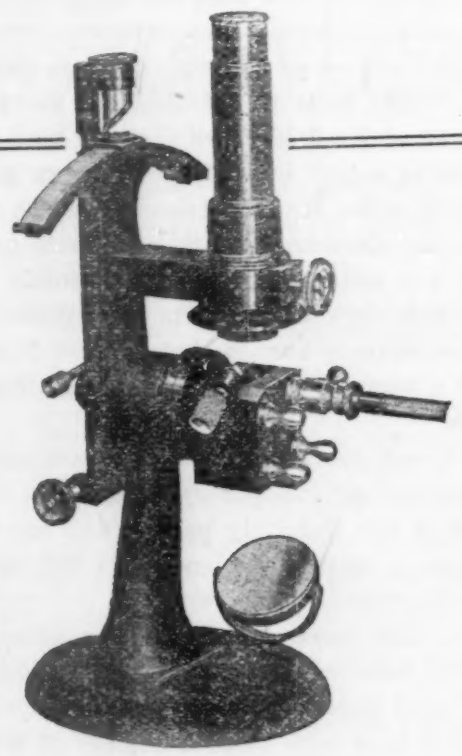

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SCIENCE NEWS

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ECLIPSES AND COMETS OF 1930

Two eclipses of the sun and two of the moon, one of each visible in the United States; the return of two periodic comets and perhaps several new ones; a gradual decline of sun-spots and solar activity, which will bring with it better radio reception—these are some of the chief events on the astronomical program for 1930.

The eclipse of April 28 is both annular and total, paradoxical as that may seem. When the eclipse starts, in the middle of the Pacific Ocean, the shadow falls just short of the surface of the earth at this phase, then it is annular. A few hours later, the eclipse reaches California, north of San Francisco. The earth being round, California is on the bulge towards the moon, and about 2,000 miles closer to it. By this time the shadow reaches the surface of the earth, and so the eclipse is total for a brief period. Then, as it passes on, the eclipse again becomes annular, crossing Hudson Bay and Labrador, and ending in the middle of the Atlantic. Even where total, however, the eclipse is very brief, and the corona, outermost layer of the sun that is seen only at total eclipse time, will flash out for but a second or two. An important eclipse observation is of what is called the flash spectrum, which appears at the instants of beginning and end of a total eclipse. In this case the duration is unimportant.

The year's second eclipse of the sun comes on October 22, and is much better from an astronomical viewpoint, for it lasts a minute and a half. But the only land from which it is visible is a tiny island of the Tonga group, in the South Pacific, called Niuafou Island, to which there is ordinarily but one steamer a month. As there are no harbors or docks, any astronomical equipment would have to be landed through the surf. Despite these difficulties, a New Zealand astronomer has decided to visit Niuafou at the time, and a party from the U. S. Naval Observatory may also go.

During the last few years the sun has been unusually active, for the eleven-year sun-spot cycle has been at its maximum. Now it has definitely passed, and the coming year should see a marked diminution in the number of sun-spots and their size.

Two eclipses of the moon are also coming this year, only one of which, however, and that a partial one, will be seen in the United States. It will occur on April 13.

Two comets, that have both made a number of returns in the past, will probably turn up in 1930. One is D'Arrest's, which comes every 6.6 years, and has been seen seven times since its discovery in 1851. The other is Tempel II, which, since its discovery in 1873, has been seen on six of its returns at 5.2-year intervals. Three other comets, Metcalf's, which was discovered by the Reverend Joel H. Metcalf, a New England Unitarian minister, in 1906, Daniel's and Perrine's, are also due, but they have not been observed on several recent returns, and may be missed again. A brilliant naked-eye comet has not been seen in the northern hemisphere for a number of years, and one may appear in 1930, but this is speculation, not prediction.

The meteor showers of August and November will come as usual. Probably the Leonids, in the latter month, will be more than usually numerous. The years 1833 and 1866 brought two very brilliant and spectacular showers of these shooting stars that seem to radiate from the constellation of Leo, the Lion. In 1899 an expected shower failed to materialize, but the following year or two brought unusually large numbers. As another 33-year interval has almost elapsed, and the Leonids of the last two years were more numerous than in the past, still more may come in November, 1930, and may herald another great shower in 1933.

WILK'S COMET

WILK'S comet, which was discovered on December 20 by an astronomer in Poland, will not become conspicuous to the naked eye, even though it is brighter than any comet discovered for several years. This announcement was made here to *Science Service* by Dr. A. O. Leuschner, director of the Students' Observatory of the University of California, following a calculation of the comet's path by E. C. Bower and F. L. Whipple.

These figures show that when the comet was discovered it was 85,000,000 miles from the earth, and that it is now moving away from us. However, it is moving towards the sun, and on that account will brighten. This will counteract the greater distance from the earth, and so it will continue about the same brilliance for a few weeks. It is now about the seventh magnitude, too faint to be seen with the unaided eye even under best conditions, but a small telescope will reveal it. After January 8, it will be so close to the sun as to be lost in its glare. On January 22, it will reach perihelion, when it will be closest to the sun, at a distance of about 60,000,000 miles. After that it will probably appear to astronomers in the southern hemisphere for a few weeks.

When discovered, the comet was near the bright star Vega, seen low in the northwestern sky for a few hours after sunset, or low in the northeast for a few hours before sunrise. Since then it has been moving south and eastward, passing near Albireo, the bottom star in the Northern Cross, on December 28. On January 5 it will pass the constellation of Delphinus, or "Job's coffin," a diamond-shaped group of faint stars seen in the west above the bright star Altair, in the Eagle, just after sunset.

The calculation of the path was made with the aid of observations at Heidelberg, Germany; Yerkes Observatory, Wisconsin, and Lick Observatory at Mount Hamilton. In order to compute a comet's orbit, three positions are required, somewhat similarly to the way in which three points determine a circle. Any number of circles can be drawn to include a single point. Any number

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Vol. III: The vegetation of Mt. Desert Island, Maine, and its environment. By Barrington Moore and Norman Taylor. 151 pp., 27 text-figs., vegetation map in colors. June 10, 1927. Price, $1.00.

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circles, with a diameter at least as large as the distance between them, may be drawn so as to include two points. But only a single circle can be drawn so as to include three given points. The farther apart the three comet positions are, the greater is the accuracy of the path. The calculations made at Berkeley, California, suggest that the comet may be the same as one of several visitors in the past, but a more accurate orbit will be needed to make the identification certain.

THE GLACIATION OF ALASKA

In spite of its far northern latitude, Alaska was at no time completely covered with ice during the Glacial Period, according to Dr. Stephen R. Capps, of the U. S. Geological Survey. Even during the so-called Wisconsin stage of the Pleistocene glaciation, when practically all Canada and most of the northeastern quarter of the United States was submerged beneath a great ice sheet, scarcely half of Alaska was glaciated. In the south, glaciers filled the valleys and crept down the slopes of the Alaska Range and of the coastal mountains; and a continuous ice front fringed the southern shores of Alaska. Similarly, in the north, glaciers descended from the slopes of the Brooks Range. But the broad central valley of Alaska, drained by the Yukon and Tanana rivers, was practically untouched by glacial action. Only small local ice streams descended from the few scattered elevations which here and there interrupt the level surface of the central valley.

The age of the principal glaciation in Alaska has been determined by a study of post-glacial peat beds and of the spruce stumps embedded in them. These stumps are remarkable for having, not one set of roots radiating out horizontally from the trunk as a center, but two or more parallel sets of radiating roots, one above the other. As the peat accumulated about the spruce trees and the line of permanently frozen ground rose higher, the roots of the trees were frozen and the tree was compelled to put forth a second set of roots. By measuring the distance between these sets of roots and counting the rings of annual growth of the trees, it has been possible to determine the length of time that has elapsed since the retreat of the glaciers. These calculations put the date of the principal glaciation in Alaska back from 20,000 to 30,000 years, and make it about contemporaneous with the so-called Wisconsin advance of the ice sheet in northeastern United States.

Transported boulders, scratched and grooved rocks, faceted pebbles and beds of boulder clay show that Alaska was glaciated at least four times during the Pleistocene period. Traces of these earlier ice invasions, however, have largely been obliterated by the last and principal glaciation, during the Wisconsin stage. The existence of similar beds containing glacial boulders shows that Alaska had an ice age as far back as the Silurian period of the early Paleozoic era; and some geologists believe that several glaciations occurred during the Paleozoic era.

At present, Alaska is believed to be in an interglacial period between two ice invasions. The total time that has passed since the retreat of the "Wisconsin" ice sheet is much less than the time calculated to have elapsed between glaciations during the Pleistocene period.

The effect of glaciation on southern Alaska was not altogether fortunate. Many rich accumulations of gold-bearing gravel were swept away by the advancing glaciers; the present placer deposits are merely the few remnants that somehow escaped destruction. In many places the top soil has been carried away by the ice and the land spoiled for farming. In other places, however, the land has been enriched by soil deposited by streams flowing from the melting ice front.

CURRENTS OF ELECTRICITY IN PLANTS

That all living things generate currents of electricity, minute but measurable, and this electricity is the force that influences their rate of growth and determines their form, was the subject of a paper by Professor E. J. Lund, of the University of Texas, given before the physiological section of the Botanical Society of America at its meeting at Ames.

The unit of electrical generation in the living plant or animal, just as in an electrical battery, is the cell. The voltage of each cell is added to that of the one in front of it in the direction in which the tiny current is flowing, and its amount and intensity have great influence in the activities of the organism as a whole.

It has even been possible to find electrical currents in living trees. In the Douglas fir and the white fir the current has been shown to flow continuously upward in the outer layers of wood and downward through the inner layer of the bark.

The existence of the currents is dependent on the activities of the living cells. They have been made to disappear by applying certain anesthetics and poisons to some cells, by depriving others of oxygen and by other means. Conversely, subjecting growing plants of various kinds to the flow of an outside current has caused marked modifications in their final form.

"The experiments distinctly indicate," Professor Lund concluded, "that the existence of continuous bioelectric currents will contribute to an explanation of how ordered growth and regeneration can occur in primitive and embryonic plant and animal tissues where no nervous or hormone mechanism is known. The facts appear to open up a new avenue of approach to many obscure and difficult problems in embryology, growth and regeneration."

Professor Lund was followed on the program by his associate at the University of Texas, Gordon Marsh, who told of experiments in passing electric currents through roots.

SOIL ACIDITY

The composition of the water plants take from the soil was the subject of a symposium before the Ecological Society of America, in which Professor J. F. McClendon, of the University of Minnesota; Professor E. Truog, of the University of Wisconsin; Professor Herman Kurz, of the Florida State College for Women, and Professor E. B. Powers, of the University of Tennessee, took part.

Professor McClendon opened with an outline of the theory of soil acidity and a description of the methods

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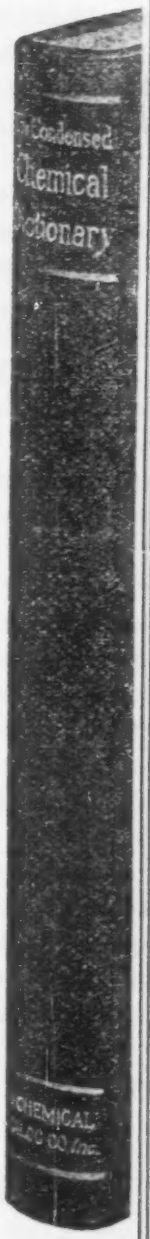

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available for testing it. The latter have progressed far beyond the simple slip of litmus paper that used to suffice and is still employed in many places. Several field kits, with graded series of delicate color tests in various solutions, can now be obtained by the student of soil acidity problems, as well as electrical apparatus for more direct measurements.

What crop plants like and do not like in soils was the subject of Professor Truog's address. It used to be flatly assumed that acid soils were bad for all crops, but the modern doctrine is not so simple as that. There are some crops, to be sure, so sensitive that they will not yield well if the acidity to which their roots are exposed rises above a very low minimum; but there are others, normally neutral-soil plants, that will tolerate a considerable concentration. Such plants are useful "breaking-in" crops for newly drained peat and muck lands, and other places where the acidity is still high. Finally, there are some cultivated plants which in their native state demand a really highly acid soil. Blueberries and cranberries belong to this class. These must be cultivated on land as much like their native habitats as possible. Realization of the acid requirements of plants has done much to help farmers and horticulturists to adapt their crops to the land available.

Professor Kurz told of studies of the relation of plant distribution to soil acidity. A sufficiently skilled botanist can walk on to a piece of land new to him and by counting certain plants tell the acid concentration of the soil with considerable accuracy before a chemical test is made at all. The pioneer work in this field was done thirteen years ago by Dr. Edgar T. Wherry, of the U. S. Department of Agriculture, who is both chemist and botanist. Since his time the work has been carried on actively by scores of researchers all over the world. It is possible not only to estimate the soil acidity by studying the plants that grow on it, but to predict with a considerable degree of accuracy the probability of finding a given species of plant if the chemical state of the soil is known.

Animals as well as plants are influenced by the chemical nature of the water to which they are exposed. This is especially true of aquatic animals, which are not only very intimately exposed to the water, but are free to move away from a locality they do not like or into one which they do. This aspect of the problem was the subject treated by Professor Powers.

BACTERIOPHAGE

"A SYSTEMATIC study of the properties of bacteriophage failed to substantiate its living nature," according to Dr. J. Bronfenbrenner, professor of bacteriology at the Washington University School of Medicine, in an address before the Society of American Bacteriologists meeting at Ames, Iowa. The evidence seems to indicate that the bacteriophage is an inanimate chemical product of bacterial metabolism, having no cell-dissolving properties of its own.

Bacteriophage has been hailed as a most potent germ-killer, being made itself from germs, but ever since its discovery by Dr. F. d'Herelle it has been a subject of scientific controversy.

"It seems to exhibit a stimulating effect on homologous or closely related bacterial species. As a result, the rate of intracellular metabolism is abnormally increased with a consequent increase in osmotic pressure within the cell and if water is available in the surrounding medium, bacteria take it up, swell and finally burst."

The activity of the phage in suppressing the effects on animal tissue of a definite germ without harming the tissue was compared with the activity of certain chemicals. The phage was active at a much wider range of dilutions than any of the five chemicals, mercuric chloride, phenol, formalin, tincture of iodine and chloramine, according to John E. Walker, of the research laboratories of E. R. Squibb and Sons. The phage was active at dilutions ranging from full strength to a dilution of 1 to 512, while the nearest chemical, mercuric chloride, could only be diluted to one sixteenth of the strength causing tissue destruction and still be active.

ITEMS

AMERICA'S most beautiful shade tree, the stately elm, may follow the chestnut to destruction if infected by the Dutch elm disease, which has already devastated the elms of Holland, Belgium, France and Germany, according to Dr. Christine Buisman, professor of plant pathology of the University of Utrecht, who spoke before the American Phytopathological Society. Methods of controlling the disease have not yet been found. The only thing that can be done now is to test varieties of elms to determine their resistance and propagate the most promising ones. There is nothing to show that the disease will decrease in the course of time. A tree first shows the effects of the disease when the twigs curl and the leaves of the whole tree or some of its branches suddenly wither and turn down. The leaves do not fall immediately, those in the top remaining for several weeks. In the wood of a diseased tree conspicuous reddish-brown streaks become visible. A tree thus affected may die within the year or it may live for several years. Most of the affected trees are from 15 to 40 years old, accounting, perhaps, for the rarity of the malady in nurseries. The disease first appeared in Holland in 1920. It has gradually spread through Belgium, France and Germany, and since 1927 it has been reported from England. The spores of the causal agent are principally disseminated by the wind and enter the wood through small wounds.

IT may soon be possible to determine the hardiness of plants by laboratory tests, as the result of experiments conducted by Professor S. T. Dexter, of the University of Wisconsin, described by him before the American Society of Plant Physiologists. When a wilted carrot or potato soaks up water and becomes crisp again, it does so largely by a process called osmosis. Just the opposite happened in Professor Dexter's experiments. He put several varieties of alfalfa roots in freezing water at different seasons. The loss of sap was measured and it was found that the hardiest varieties lose least sap in the winter. "If the measurements in the experiments can be standardized," Professor Dexter believes that "they may serve as indices of plant hardiness."

INFECTION

With a Virulent Culture

Suppressed by Vitamine-B Feeding

Very remarkable experiments were recently conducted at Yale University Med. School, by Drs. Rose & Cowgill. (Soc. for Exp. Biol. & Med. May.)

A series of healthy animals were injected with living cultures of Bacillus Welchii. When the animals received a regular diet, low in vitamine-B, bacteria developed, pus areas were established and B. Welchii were found in the blood stream.

But, when an adequate amount of Yeast Vitamine-B Concentrate (Harris) was added to the diet, negative blood cultures were obtained. The authors state: "—This procedure was repeated a number of times over a period of 15 months and the same results obtained."

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SCIENCE NEWS

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EARTHQUAKE WAVES

As the surgeon examines the interior of his patient's body by means of X-rays, so are scientists becoming able to study the interior of the earth by means of earthquake waves, produced naturally, or artificially by a dynamite blast. At the meeting of the American Association for the Advancement of Science, the Reverend James B. Macelwane, S. J., of St. Louis University, predicted increasing use of this method that has so successfully been used to locate oil-bearing salt domes.

"There appears to be not only a remote possibility but a high probability of the increasing use of seismic methods for the exploration of the hidden portions of the crust of the earth," he stated. "The prospect has for us a sort of fascination. We are able as it were to hold the earth up to the light and look through it. The earth is as transparent to seismic rays as a ball of glass would be to light. The earthquake or dynamite blast is the flash and the eye we use is the seismograph. So much progress has been made in the last two decades that we may look forward in the next few years to a great increase in our knowledge of the planet on which we live."

Dr. Macelwane also told of the faults, or cracks, that produce such earthquakes as that of San Francisco in 1906, and the fractures that sometimes are caused by the quake.

"Why do such fractures occur?" he asked. "Is there any way of telling where to expect them? In most mountain systems we find faults of this type. Folding and fracture seem to be the ordinary ways in which mountains are built up. Hence we should expect many earthquakes in regions where mountain-building is in progress. Where high mountains are made up of rocks which only comparatively recently were laid down as sediments it is more difficult to see why horizontal movements should occur along nearly vertical fractures.

"However, some explanations have been offered which seem very plausible. If we take a column of rock reaching from one hundred miles below sea-level up to the top of a high mountain chain and take another column of the same cross-section under a level plain or a valley, the mountain column will be much higher and should weigh more than the plain column if they are composed of the same kind of rock. However, the United States Coast and Geodetic Survey finds by careful measurement that the two types of columns in general weigh the same.

"This is stranger than it seems, for let us suppose that the two columns weighed the same a hundred thousand years ago. Every time it rains some of the material is washed off the top of the mountain and some more is deposited on top of the plain as is happening now in the Great Valley of California. As this process goes on, the mountain column should become shorter and the plain column longer. The mountain column should become lighter and the plain column heavier. But again it is found that they keep on weighing the same. This can not be true unless there is some type of compensation going on. There must be a movement of material out of the plain column and into the mountain column.

"If the rocks below the earth's crust were liquid such flow would be easy. But we know from what earthquakes tell us, that the rocks at those greater depths are not only solid but they are more rigid than steel. If they flow, then they must flow as steel does in the die. And if cold rigid rocks flow in this manner, they pull with great force on all the neighboring rock mass with which they are connected and they carry with them in their movement the rocks above them to which they are attached. This is one explanation for earthquake movements of the type we have just considered."

ROTATION OF THE GALAXY

ROTATION of the galaxy—the system of stars of which the sun, the milky way and all the visible stars are part—around a distant and massive center, helps explain the peculiar motions of the bluish-white stars classified by astronomers as type B. This announcement was made to the astronomers at the meeting of the American Association by Dr. J. S. Plaskett, director of the Dominion Astrophysical Observatory, at Victoria, B. C.

Dr. Plaskett explained that the stars of type B, which are classified by the lines that appear in their spectra when their light is analyzed, all are moving from or towards the sun with much smaller speed than any other spectral type. But the curious fact has been found that most are moving from the sun, as if the whole system of these stars was expanding around the sun as a center. The average speed away from us is about five kilometers (3.1 miles) per second.

Though various suggestions have been made to account for this anomaly, such as errors of measurement, Dr. Plaskett has found that most of them agree with what would be caused by a rotation of the whole stellar system.

However, this only explains the motion of the fainter B type stars. Those brighter than the 5.5 magnitude, that is, those closest to the sun, still showed such a motion, even taking into account the galactic rotation. None of the other causes suggested would explain this, he declared.

"It is inconceivable that these causes should not operate in exactly the same way and to the same degree for faint as for bright stars. To imagine any physical property of this uniform class of B stars which depends only upon the apparent brightness, or, in other words, the distance from the sun, an insignificant star in the system, and only about one thousandth as luminous as the B stars, is to carry anthropomorphic prejudices to an absurd degree," said Dr. Plaskett.

Actually, he has found, the closer ones happen to be members of a special group of B stars in the constellations Scorpio and Centaurus, which actually show an unusually high speed for stars of this type. As a result of this work, he has found that the average speed of the

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B type stars ranges from about 9 kilometers (5.6 miles) per second for the brighter ones to 12 kilometers (7.4 miles) per second for those fainter and more distant. Great as this speed seems, it is less than the motions of stars of any other type.

SUN-SPOTS AND RADIO

If you think that distant radio broadcast stations have failed to come in as well in the last two or three years as they did in the early days of radio in 1923 and 1924, despite the more powerful stations nowadays, you may be justified. Activity of the sun, as shown by large numbers of sun-spots, was to blame. With a decline in the number of sun-spots scheduled for the next few years, you can look forward to a time of good reception of distant stations, according to Dr. Harlan T. Stetson, director of the Perkins Observatory at Ohio Wesleyan University. Speaking before the astronomers attending the meeting of the American Association for the Advancement of Science, he told of his latest researches on the relation of sun-spots to radio. He began this work at Harvard University in collaboration with Dr. G. W. Pickard, a Massachusetts radio engineer.

A year ago, at the association's meeting in New York, Dr. Stetson predicted that the autumn of 1929 would see a marked increase in the number of sun-spots, associated with poor radio reception on the broadcast bands. This was made on the basis of a regular increase in the spots and decrease in radio intensity that came every fifteen months. He stated that "the radio reception registered in 1929 has tended to follow the same 15-month cycle observed in the sun-spot numbers, with a marked depreciation during the recent fall maximum, when, under normal conditions, radio reception should have been improving with the decreasing hours of sunshine."

Dr. Stetson made the following prediction for the future:

"Forecasting on the basis of the 15-month cycle, the year 1930 should show a general decrease in sun-spot numbers as the year waxes, with a corresponding increase in radio signal strength in the broadcast zone. By the very end of 1930 and the beginning of 1931, the general rise of a secondary sun-spot maximum should be evident. By 1931, however, it is believed that we shall be so far from the maximum of the 11-year period that the secondary maximum will have no effect upon radio reception and allied electro-magnetic phenomena as have the sun-spot maxima of 1928–29. The general lifting of the ionization level in the earth's atmosphere should continue, with the fluctuations noted, through the next six years, but in 1934 solar activity should be as quiescent as at the last minimum of 1923."

Dr. Stetson believes that these radio changes are produced by variations in the height of this ionized layer of the atmosphere, known as the Kennelly-Heaviside layer. Long waves of 18 kilocycles show an opposite effect. Their reception is best when sun-spots are most numerous.

OZONE IN THE UPPER ATMOSPHERE

As one may sleep warmly out of doors under a quilt, or shiver under a sheet, so the upper atmosphere, the stratosphere, is kept warm over Arctic latitudes by a thicker layer of ozone. This was the explanation for a curious fact that has puzzled scientists, given before the American Meteorological Society by Dr. W. J. Humphreys, of the U. S. Weather Bureau.

The stratosphere is the layer of the atmosphere above the highest clouds, and, unlike the lower layers, does not become colder with height. Temperature observations have been made of this layer by means of small balloons, equipped with recording thermometers. "They reveal the curious fact," said Dr. Humphreys, "that the stratosphere is coldest over equatorial regions and becomes gradually warmer with increase of latitude, the extreme difference being around 35 degrees Fahrenheit—coldest over the warmest earth and warmest over the coldest earth."

Though a full explanation has not yet been made, Dr. Humphreys thinks that it is due to the ozone. Observations have shown that there is less ozone over equatorial than over Arctic regions, a fact that is itself yet unexplained. But the ozone absorbs radiation from the earth, and reradiates part of it back again. Therefore, where there is more ozone, more heat is sent back, and so the upper atmosphere there is warmest.

"THE CORNFIELD'S MICRO-CLIMATE"

How a cornfield to a certain extent makes its own weather was related by Dr. J. M. Aikman, of Iowa State College, before the Ecological Society of America, meeting in Des Moines.

As everybody knows, weather has a great influence on crops; but the weather we get from the Weather Bureau might be called just "average" weather. The cornstalk in the field is not interested in averages; what affects its life is how much sunlight reaches its individual self, and to what extent it has to give up, by evaporation, the water it has drawn from the soil.

Dr. Aikman set out to study the "micro-climate" of a cornfield, as affected by the corn plants themselves. He set out instruments to measure the humidity and evaporating power of the air, the temperature of air and soil, and the intensity of sunlight. He measured three different plantings of corn in this way: one a field with two stalks to the hill, one with three and one with five.

In general, he found that the denser the stand the higher the humidity, the lower the evaporation rate among the stalks, and the less sunlight reached the lower leaves. The evaporation rate, for example, was ten per cent. higher in the "thin" field than in the densely planted one. Missing stalks in the hills, causing irregular gaps in the field, introduced wide fluctuations in all the "micro-climatic" readings.

FOODS OF INSECTS

Insects have choices as to what they will eat and what they will reject, no less than humans or horses. Some of them will eat almost anything that they can fasten their jaws on, while others will reject all but a single item on the whole wide world's bill of fare. At a session of the Entomological Society of America, Professor C. T. Brues, of the Bussey Institution, Harvard University, reviewed the varied table manners of different kinds of

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insects and discussed the effects of these preferences on man's affairs.

The cockroach, one of the most ancient and primitive of all insects, is also one of the least "choosy," Professor Brues said. It will eat almost anything, either vegetable or animal, but other insects equally ancient, like the dragonflies, already show special preferences, sticking strictly to a diet of freshly captured insects. Some of the later-developed insect groups show a gradation in choice within a single family or genus. Some species of wasps, for example, are willing to use a variety of spiders and insects in provisioning their nests, while others depend on a single species to supply them with meat.

The same is even more strikingly the case among plant-eating insects. Everybody knows how thoroughly grasshoppers strip vegetation, and in the East the Japanese beetle is establishing a record almost as bad. Others again will feed on a number of different plants, as the gipsy moth caterpillar feeds on several kinds of shade trees; but these have a more limited number of host plants.

Among the worst of the pests man has to deal with are insects so highly specialized that they can not or at least will not feed on anything but one kind of plant. The potato beetle and the cotton boll-weevil are high on this "bad eminence." It is largely against them that quarantine barriers are erected, and for their undoing that entomologists comb the world seeking other insects that will kill or weaken them or prey upon their eggs and young.

PLANT MIGRATIONS

THE classic boast of the old cowboy song, that "I've swum the Mississippi and I've clumb the Great Divide," is true for rooted plants no less than for beings blessed with means for bipedal locomotion. Plants also climb the Great Divide, Professor Aven Nelson, of the University of Wyoming, veteran western botanist, told members of the American Association for the Advancement of Science. One of these passes accessible to plants is in Yellowstone National Park.

"A certain small area in Yellowstone Park," said Professor Nelson, "is a sort of 'no man's land' out of which the headwaters of three great river systems spring—the Yellowstone, the Snake and the Green as important tributaries of the Missouri, the Colorado and the Columbia system. It is to be remembered that the watershed divide does not necessarily coincide with the high peaks and ranges. The Continental Divide in certain places is found on high table-lands so level that only the observed drainage or the surveyor's instrument can locate it.

"These high table-lands, often of great extent, lying between the interrupted ranges, constitute the passes that permit the construction of great roadways connecting the East with the West—the Union Pacific Railroad, the Lincoln Highway and the Transcontinental Airways, for instance. It may be well also to remind ourselves that these passes permit not only the mingling of peoples but of plants. Were the barriers more complete we could speak more definitely of a Pacific and an Atlantic flora.

"It is no longer true of either flowers or folks, that 'The East is East, and West is West, and never the twain shall meet.' Modes of travel to satisfy their wanderlust were devised by plants long before we ever dreamed of automobiles and airplanes. The embryos of the cocklebur and cottonwood tree ride and fly with more security than we."

But although native plants have been using these passes for thousands of years, the number of introduced weeds is as yet comparatively small, Professor Nelson added. This is because, measured by the years of its settlements, this area is young.

"Man is usually the responsible agent for introductions," he continued. "Waifs and adventives follow his adventuring as do inappropriate common names. He drags plants and names in, figuratively by their heels and literally on his own."

ITEMS

NAVAJO Indians employed in road work in Mesa Verde National Park saved for the park its one and only elderberry bush, which had to be moved from its old location to permit the construction of a portion of the scenic Knife Edge road. The Navajos channeled about the roots of the bush so that it would be moved in a large block of earth. Then when the new hole was made, cables were adjusted, hooked over the shovel teeth, the bush raised, taken by shovel to the new location, and reset. The bush, a very fine and large specimen, was then cut back approximately forty per cent. to insure its future growth.

A STUDY of the bacteria that cause the peculiarly unpleasant musty odor sometimes found in eggs was reported to the Society of American Bacteriologists meeting at Ames by Max Levine and D. Q. Anderson, of the Iowa State College. The organisms causing the mustiness have been isolated and their characteristics were described at the meeting. The development of mold on the shells of eggs in cold storage depends on conditions surrounding the eggs previous to storage, L. H. James and T. L. Swenson, of the U. S. Bureau of Chemistry and Soils, reported at the same session. Chief among these conditions was the shipment of eggs in unseasoned wood.

THE partial sterilization of soil by heat has recently been investigated by Dr. W. F. Bewley, director of the Experimental and Research Station at Cheshunt, England. Dr. Bewley finds that the heat not only destroys pests and diseases but also greatly increases soil fertility and encourages the production of healthier plants. Soils are heated for about half an hour at the temperature of boiling water. Heavy soils require more heating than light sandy soils. The bacteria and fungi which cause diseases in plant roots are destroyed, but the beneficial soil bacteria are not killed and have fuller scope for their development. The heat also causes complex organic and inorganic substances to be converted into simpler substances which are more useful for the plant and the soil bacteria.

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SCIENCE NEWS

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CHEMICAL MUFFLER TO ELIMINATE CARBON MONOXIDE

A CHEMICAL device to replace mufflers on automobiles that will eliminate the deadly carbon monoxide contained in the exhaust gases has been developed by Dr. J. C. W. Frazer, professor and chairman of the department of chemistry at the Johns Hopkins University.

Since carbon monoxide, odorless, colorless, tasteless and poisonous swiftly in small concentrations, claims many lives each month through the carelessness of automobilists failing to open garage doors before warming up their engines, this latest chemical achievement is hailed as an important step in making the machine age less dangerous. Dr. Frazer said that an automobile equipped with the new oxidizing device could be run in a closed garage without danger from carbon monoxide poisoning.

Because of patent claims, Dr. Frazer has not yet revealed the exact nature of the material that transforms the deadly carbon monoxide to carbon dioxide, the same gas that human beings breathe out of their lungs. But it is known that it is a catalyst, a substance that causes a chemical reaction without itself participating. It is similar in action to the catalyst, consisting of manganese dioxide and copper oxide, that was an outgrowth of chemical warfare work by Dr. Frazer and a laboratory staff during the war. Fire departments and mine rescue squads use gas masks to-day that rely on their war-time catalyst for purifying the air of carbon monoxide.

For a year and a half, Dr. Frazer worked to develop the new catalyst that will add oxygen to carbon monoxide even when in direct contact with hot, moist gases. Laboratory tests and thousands of miles of road testing convince him that a canister of the catalyst substituted for the regulation muffler will not only deaden the noise of the engine explosions, but remove all the unburned fuel gases in the exhaust, the ill-smelling ones as well as the deadly carbon monoxide. As about a third of the fuel is unconsumed in the engine cylinders, the small canister of catalyst has the task of burning half as much fuel as the engine does. Heat from this reaction may be utilized in some way in future installations, such as for car heating or preheating the fuel.

At present only one experimental unit of the catalyst muffler is in operation, mounted for convenience on the running board of Dr. Frazer's experimental car. A company for the commercial exploitation of the invention is in the process of organization.

AIRPLANE SAFETY

RATHER than expect airplane pilots to be supermen, who will always function at one hundred per cent. efficiency in an emergency, designers of airplanes must try to improve the construction of their machines to the point where they will be easier to land, will not have a tendency to spin and have satisfactory "controllability." Such are the conclusions reached by the National Advisory Committee for Aeronautics in its annual report recently made to Congress.

The Department of Commerce made an analysis of air-accidents in 1928, and came to the conclusion that in nearly half the mishaps, the pilot was to blame. Had his judgment been better, or had he not become confused by some untoward set of circumstances, had his "reaction" been better and quicker, the situation would have been met adequately. While this is all true enough, and while medical supervision of pilots, always strict, is likely to become even more stringent, nevertheless, flying should be made safer through the elimination from airplanes of to-day of certain undesirable aerodynamic characteristics.

It may be necessary for military airplanes to be able to spin for military maneuvers. It is neither necessary nor at all desirable for civil airplanes to have this tendency. Other factors in airplane safety which have to do with design are stability and controllability.

Whether the controls are being held by the pilot or left free, one should be able to proceed in a desired direction and at a desired altitude. Many airplanes do not have satisfactory stability in stalled flight. Scientific work is going on all the time in an effort to work out improved stability.

As for the factor of controllability, it is noted that while most airplanes have satisfactory controllability in normal flight, if the plane is stalled, the controls operate in a most confusing manner. After a spin has developed for several turns, it is often true that the controls become ineffective. While work is proceeding in an effort to solve this problem, there is much still to be done.

The formation of ice on airplanes is regarded as an element of danger, and this question is being studied at the Langley Memorial Aeronautical Laboratory. Protective coatings for aircraft surfaces have been attempted, but have not shown themselves to be conspicuously successful as yet. Glucose or corn sirup and certain liquids such as a mixture of glycerin and alcohol seem to have some effect in preventing the formation of ice.

After the factor of safety is solved, there will still remain the problem of making air travel reasonable in cost. Scientific research will solve both problems, in the opinion of the committee, and sufficient financial backing for this work should be given.

TALKING MOTION PICTURES

REDUCTION in the cost of distributing talking movie records to theaters, along with better reproduction of sound, is foreseen as the result of the development of "durium," a new synthetic resin that will make cheap and almost indestructible phonograph records.

While many of the talkie producers record the sound track on the film alongside the picture, from which it is converted back to sound by a photoelectric cell, the flat

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disc record still finds wide use. One large producer uses such records entirely, while several others produce their films with both kinds of record, leaving it to the theater operator to decide which to use.

With the old heavy disc records, made out of the same material as phonograph records used in the home, but 16 inches in diameter, shipping costs mount rapidly. The records are always sent in duplicate, and, to large theaters, in triplicate, so that breakage of a record will not stop the show. Furthermore, a single record can not be used more than 10 or 15 times, without the scratch becoming too apparent.

The durium records are made by coating the new synthetic resin on heavy paper and embossing the grooves of the sound tracks into it. They are light and unbreakable, thus cutting greatly the shipping and packing costs. They will stand all kinds of rough treatment, such as hammering, bending, heating or scratching, without impairing the sound track. They have practically no surface noise and can be played for a hundred or more times, according to the claims of the inventor.

Dr. Hal. T. Beans, of Columbia University, is the inventor of the new resin, the chemical details of which are not yet known because of the patent situation. Before long his company will produce a weekly 10-inch record of a new song hit, to be sold at a low price and playable on any phonograph. In addition, it is claimed, durium can be used as a spray for coating objects to waterproof and fireproof them, and also that large objects, such as toilet articles, can be made from it.

FLOOD CONTROL CANALS

ON a scaled model of the Des Moines River at Ottumwa, Iowa, hydraulic engineers of the state university have accurately determined the effect of cut-off canals around bends near the city and have advised a building program that has actually proved itself in miniature.

This was probably the first attempt in the United States to determine with models in advance of actual field construction the benefits to be derived from straightening rivers. It was very successful.

Ottumwa, a city of 27,000, has suffered often from floods. There are two big bends in the river, one just above and one just below it, and at the end of the first bend the city owns a power plant supplied with water by a canal across the neck of the bend.

The city wanted to enlarge this canal to increase the capacity of the power plant and at the same time wanted to know what effect this enlarged canal and a second one across the other bend would have on the height of flood waters.

The model was constructed of concrete reproducing exactly an area of the river valley 8,000 feet wide and 33,600 feet long containing the two bends and a part of the city. A horizontal scale of one to 800 and a vertical scale of one to 100 was used. Water was run through the miniature river at different heights, with and without the proposed canals cut, and accurate measurements of water flow and heights were taken.

The recommendations made, which will doubtless save Ottumwa both money and time, call for the construction of the two canals not more than 400 feet wide and as deep as the river, and for the removal of a number of levees.

CONTROL OF THE SAND FLY

SAND flies, so tiny that no screens can keep them out, and so ferocious that they recently broke up a horse show in Charleston, South Carolina, by their attacks on both men and animals, are to be studied by the Department of Agriculture this year, according to present plans.

An item of $16,000 for this purpose is in the Agricultural Appropriation bill, which recently passed the House, and is now before the Senate.

Although these flies have been a pest for years along the South Atlantic coast and also around the Gulf Coast, it is only this year, due to the pressure applied by realtors, chambers of commerce, and the like, that an appropriation has actually been recommended by the Bureau of the Budget for eradication purposes.

Representatives from the affected states told the House Committee on Appropriations, recently, that many wealthy persons spending money to beautify and restore old homesteads in the South were becoming discouraged in their plans to occupy these estates, on account of the sand fly. It is practically impossible to keep dairy herds on account of this pest, it is said.

Representative Ruth Bryan Owen stated that conventions of citizens who had banded together to fight the sand fly in her district had discovered that a mixture of sand and Paris green scattered on the surfaces of swamps had seemed to help in keeping the insect from breeding. She expressed a hope that other and more far-reaching methods might be worked out under the Department of Agriculture supervision.

CALENDAR REFORM

CALENDAR-REFORM action by the League of Nations in 1931 may make it unnecessary for Representative Stephen Porter, of Pennsylvania, to press his resolution authorizing the United States to send delegates to an international conference on changes in the calendar at some future time.

According to recent word from the National Committee on Calendar Simplification, the subject of calendar reform is to be discussed in the league's general assembly next year. It is one of the subjects under the general heading of "General Conference on Communications and Transit."

Since the United States usually takes part in such assembly discussions, even though it is not a member of the league, it is assumed that it will do so in 1931, and that action taken will be definite treaty action on the part of all countries.

Such action, however, would of course have to be submitted to various countries for ratification. It is possible, though it scarcely seems probable, that such ratification could proceed with sufficient speed, in the event of a determined change, that the new calendar may be put into effect in 1933.

Representative Porter recently stated that he was not pressing action on his resolution at the present time, but

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The National Research Council of Canada will, in the near future, make the following appointments to the staff of the Division of Pure and Applied Physics of the National Research Laboratories:

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(6) A Junior Physicist whose aptitude and training qualify him to undertake research work in the field of ultrasonics.

(7) A Junior Physicist or Physical Chemist whose aptitude and training qualify him to undertake research work in the field of radioactivity.

(8) A Research Engineer whose aptitude and training are for work in the field of electrical engineering.

(9) A Research Mathematician whose aptitude and training have been in the field of mathematics, and who is competent to assist and advise in problems of aerodynamics and hydrodynamics.

(10) A Research Mathematician whose aptitude and training have been in the field of mathematical or theoretical physics, and who is competent to assist in connection with problems in the field of mathematical physics.

The salaries of the above positions vary upward from $2,100 per annum, according to the qualifications and experience of the persons appointed. Interested applicants should apply immediately giving references and full particulars as to their scientific training, professional experience, and enclosing a recent photograph. Applications should be addressed to: S. P. Eagleson, Secretary, National Research Council, Ottawa, Canada.

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The Government of Bombay invite applications for the post of Chief Agricultural Officer in Sind, who will work under the Director of Agriculture, Bombay Presidency, with headquarters at Karachi.

Applicants should possess an honours degree in science or agriculture, but preference will be given to applicants who have had experience in large scale agriculture and particularly irrigation agriculture and who also possess administrative ability and experience. The officer appointed will control and direct the research propaganda and development work of the Agricultural Department in Sind which will be mainly in connection with irrigated land, much of which contains alkali.

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was marking time to see what other countries were going to do.

What is becoming known as the "Thirteen Months Business Calendar" has now been adopted by several business concerns, among them the Mutual Stores of California and Sears, Roebuck and Company.

ITEMS

WHAT is probably only the second or third occurrence of psittacosis, or parrot fever, in this country has been reported from Annapolis, Md., where three people are seriously ill with this little-known but highly fatal malady. The disease was contracted from a parrot bought three weeks ago. The bird died at Christmas. The germ causing the disease has never been determined, although several organisms have been suggested. The disease has symptoms typical of pneumonia, develops within a week or ten days after exposure, lasts about 15 or 20 days and causes death in nearly half the cases. Outbreaks have been reported in European and South American countries, and two others, one in Boston and one in Hollywood, California, have been reported in the United States besides the one in Annapolis. There is no indication of the disease being transmitted from man to man, Dr. George McCoy, of the U. S. Public Health Service, stated, so that probably no danger of an epidemic exists.

"THE time is not far distant when a new major decline in tuberculosis may again take place," statisticians of the Metropolitan Life Insurance Co. have just declared. Their earlier prophecy that 1929 would see the lowest tuberculosis death-rate ever recorded in the United States will certainly be fulfilled, they found after a review of the latest figures. Reports through the end of November, the latest available, showed a rate of 85.9 per 100,000, which is a decline of 5.7 per cent. as compared with the corresponding period of 1928. Tuberculosis will some day rank among the relatively minor causes of death. A death-rate of 40 per 100,000 will probable be approached during the next ten years.

METALS can be superhardened by magnetic treatment as well as by heat treatment, E. G. Herbert reports before the Iron and Steel Institute. Magnetic hardening is accomplished by repeatedly changing the polarity of the steel, Mr. Herbert explains. A specimen so treated could not be hardened more by low temperature annealing, he says. Whether the magnetic treatment is apt to become of commercial value is not indicated. It is evident that both magnetism and heating produce the same atomic rearrangement. This phenomenon may lead to the finding of additional information about the structure of magnetic metals.

AN aviator coming to earth through a dark sky can see a landing field covered with whitewashed crushed stone 15 times as well as he can see one paved with asphalt, aviation lighting engineers of the General Electric Co. report. To light both fields equally well, 15 times as much light is required for the asphalt as for the rock, they point out. Many surfaces have been tested and given a reflection factor. The stone reflects 75 per cent. of the light it receives and the asphalt reflects five. For Portland cement the figure is 30 per cent.; for crushed stone, 25; crushed slag, gravel and clay soil, 20; sandy soil, 10 to 12; cinders, five to 10; black soil, five to eight, and asphalt, five.

THE white potato, known as "Irish," whose more than 350,000,000 bushel annual production in the United States is the root of so serious an agricultural problem that the Federal Farm Board has set it apart for special treatment, is a native of America, like corn and tobacco. The Incas of Peru had it under cultivation for centuries before the Spanish invasion. The tuber's history, from the time it was an important food in this lost South American civilization, as prehistoric mounds show, was traced through a slow rise to its present-day place of prominence next to bread, by William Stuart, of the U. S. Bureau of Plant Industry, at the meeting of the Potato Association of America in Des Moines. For 150 years after its discovery by Europeans, only well-to-do people ate the potato. It was raised in their gardens and the lower classes knew of it by hearsay alone. Commercial production was begun about 1750. Now, by artificial propagation and sexual reproduction, science is producing new and improved varieties of the original potato.

BELTS of dead and blasted trees, standing like macabre processions around the edges of lakes created or enlarged by power and irrigation dams, are now things of the past, according to an announcement made by Dr. Ray Lyman Wilbur, secretary of the interior, before a meeting of the president's committee on outdoor recreation. Such eyesores are being removed where they exist, he said, and all new permits for the construction of dams on the public domain now have inserted in them clauses providing for the removal of all trees likely to be drowned, before the water is allowed to back up over their roots. This action has come as the result of the increasing use of publicly owned lands as recreational and educational areas, for tourists and students of nature alike have found such skeleton fringes as now disfigure the shores of Jackson Lake and other bodies of water most objectionable. The cost of removal is relatively low, if the work is done before the shores are submerged.

BLIND persons do not hear better, they simply seem to because they listen harder, Mrs. Winifred Hathaway, of the National Society for the Prevention of Blindness, recently told members of the Michigan Educational Institute. The popular belief that blind people have more acuity of other senses, such as hearing and touch, is not exactly correct. The special senses of blind people, aside from sight, are no better in the beginning than those of other people, sometimes not as good. But experience and specialization on the part of the blind persons enable them to make their other senses take the place of sight, so that their senses are better developed than those of normal people. The same thing applies to deaf persons who appear to have much keener vision than normal.

INFECTION

With a Virulent Culture

Suppressed by Vitamine-B Feeding

Very remarkable experiments were recently conducted at Yale University Med. School, by Drs. Rose & Cowgill. (Soc. for Exp. Biol. & Med. May.)

A series of healthy animals were injected with living cultures of Bacillus Welchii. When the animals received a regular diet, low in vitamine-B, bacteria developed, pus areas were established and B. Welchii were found in the blood stream.

But, when an adequate amount of Yeast Vitamine-B Concentrate (Harris) was added to the diet, negative blood cultures were obtained. The authors state: "—This procedure was repeated a number of times over a period of 15 months and the same results obtained."

This is the first instance in the chemistry of immunity, where a factor of the diet has shown such importance in establishing anti-bodies or in combating infectious disease.

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GRIPPE—INFLUENZA—PNEUMONIAS

and isolated pus areas, which often follow these.

Are Pellagra and Herpes Related?

Since Dr. Goldberger (U. S. P. H. Service) cured cases of pellagra with Brewers' Yeast-Harris and Dr. Gerstenberger (Lakeside Hosp. Cleveland) successfully treated Herpes with Yeast Vitamine Tablets (Harris), are these diseases similar in origin and were they cured by "immunity building" or by supplying Vitamine-B deficiency?

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SCIENCE NEWS

Science Service, Washington, D. C.

A FILM PHONOGRAPH

BORN of the talkies, a film phonograph capable of playing continuously for two hours from a 400-foot reel of motion picture sound film has been perfected by Dr. C. H. Hewlett, engineer of the General Electric Company. From a reel of film small enough to fit into a coat pocket a complete play or opera can be reproduced, which otherwise would require 15 to 20 ordinary 12-inch disc records.

Talking motion picture technique allowed Dr. Hewlett to achieve his result. In one of the principal methods of recording sound for the talkies, a jagged line photographed on the edge of the film is the representation of the sound. Light passes through a narrow slit, through the film on to a photoelectric cell. As the teeth of the jagged line pass by the slit, they vary the amount of light reaching the cell, which in turn varies the intensity of an electric current. When this current is amplified and fed into a loud speaker, a reproduction of the original sound emerges.

Dr. Hewlett's film phonograph record has no sequence of photographs and contains only sound records. It lacks the perforations of ordinary motion picture film. At present there is space for nine separate sound tracks side by side, but he hopes soon to increase its capacity to fifteen. When the film has run through once it is necessary to shift to the next sound track. In early models this was done by recording the second track backwards, and reversing and shifting when the end was reached. The third track ran forward again, and the operation was repeated until the film ended.

Now, however, a continuous loop of film is used, unwinding from the inside as it winds up on the outside, after the fashion of automatic movie machines used for window displays. When a track ends, the machine shifts automatically to the next in a fraction of a second, with practically no interruption of sound. With this system and nine tracks, a program lasting an hour and twenty minutes can be played without attention. With fifteen tracks the machine will play for over two hours.

Recording is done through the same kind of microphone as used in radio or ordinary record studios. The light from a 50-watt incandescent lamp passes over a straight edge close to the lamp, and is focussed on a small mirror made to vibrate electrically in step with the sound waves. The edge is reflected upon a small slit, so that, as the mirror oscillates, the light shining through varies. A microscope lens focusses this slit on the film one tenth its actual size, and as the film moves along, the jagged line is photographed.

MICRO-ANALYSIS

A NEW discovery, of value to scientific research and to industry—the chemical analysis of particles so small that hitherto they defied all attempts to determine their composition—was explained recently by Dr. W. C. MacTavish, professor of chemistry at New York University. The analyses were made by two young Austrian chemists now connected with New York University—Dr. Anton Benedetti-Pichler and Dr. Joseph Niederl, both of them former students of Professor Fritz Pregl, who received the Nobel Prize for his work in micro-analysis. Both come from the Chemical Institute of the Technical High School at Graz, Austria.

Dr. Niederl demonstrated a method of analysis discovered by one of his pupils at New York University, William Saschek. He termed it the "microvaporimetric molecular weight method of analysis," by which he determined the composition of a fraction of a drop of liquid. Then Dr. Niederl explained that there are as yet only three other laboratories equipped to do micro-analysis—that of the Rockefeller Institute, where he helped to install the apparatus, and the laboratories of Columbia and the Johns Hopkins Universities.

Illustrating the value of the method, Dr. Niederl explained that he recently had determined for one of the leading New York laboratories the chemical constituents of a small drop of substance produced in an effort to find a rubber substitute and that upon another occasion Dr. Pichler had determined microscopic impurities in iron that was being galvanized. The method may be used in determining the genuineness of old paintings and coins, he said.

In demonstrating the micro-vaporimetric molecular weight method, Dr. Niederl analyzed about a third of a drop of liquid contained in a capillary tube. The tube was placed in mercury and then broken, releasing the liquid. The mercury was then heated until the liquid from the tube became gas. As the gas expanded it forced off an amount of mercury equal to its volume. By taking into consideration the temperature at which the gas was vaporized, together with its volume, its molecular weight was determined. Dr. Niederl said a method of analyzing mixed substances was now being developed.

Dr. MacTavish also demonstrated an automatic chemist that uses an electric eye to keep the analysis under control. The device is fairly simple. A beam of light is cast through the liquid being analyzed so that it falls upon a photoelectric cell. Above the beaker containing the liquid under investigation is a tube which passes an acid drop by drop into the beaker. A small amount of chemical indicator added to the liquid in the beaker makes the liquid red, so that the beam of light passing through it is not powerful enough to operate the relays connected with the photoelectric cell.

When a sufficient amount of acid has dropped into the beaker the red color disappears, indicating complete neutralization. This allows enough light to pass through the liquid to operate the relays and give the chemist a signal that his test has been completed.

"Using a robot of this kind around a chemical laboratory will save a great deal of the chemist's time," Dr. MacTavish said. "Its electric eye is ten times as sensi-

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tive as the human eye and will distinguish shades of color impossible to the chemist.''

A colleague of Dr. MacTavish, Dr. H. M. Partridge, has perfected a method of producing lithium in such quantity as to make it commercially available at low cost. Although it formerly cost $20 an ounce, it now is produced for $20 a pound, he said. He has prepared one piece about the size and shape of a baker's jelly roll, which is probably one of the largest pieces ever made. The metal weighs one fifteenth as much as iron and is fifteen times as bulky. It is so light it floats in kerosene, having only one half the specific gravity of water.

''One of the unique properties of lithium,'' Dr. MacTavish explained, ''is that it will unite with nitrogen at ordinary temperatures and makes possible the direct synthesis of ammonia. In the present methods of making artificial fertilizers from nitrogen in the air the chemical reaction takes place in an electric arc having a temperature of several thousand degrees.''

THE BRAIN OF THE HAGFISH

DETAILED examination of the structure of primitive brains has shown an unexpected complexity in the arrangement of their connecting fibers, but at the same time has demonstrated the fundamental unity of the animal nervous system. The work was done by Dr. J. L. Conel and Dr. Jan Jansen, of the University of Chicago, and is summarized in *Physiological Zoology* by Professor C. Judson Herrick.

The unit of nervous action usually shown in the textbooks is the ''reflex arc.'' This involves a sense organ, a sensory nerve leading to the brain or other nerve center, and another nerve, the motor nerve, leading out again to muscle, gland or other tissue that registers the response. On the basis of this, it might have been expected that the simplest brain would show a simple and orderly grouping of a relatively limited number of such arcs.

But when the two anatomists actually analyzed a number of primitive brain types they found a quite different picture. They worked on hagfish, which are the lowest of vertebrates; and these are compared by Professor Herrick with the tadpoles of frogs and toads, together with related animals, the salamanders, ''mud-puppies'' and ''Hell-benders.'' The hagfish brain proved to be no simple switch-board for a few separate reflex arcs, but bewilderingly complex, though of course the complexity was of a different pattern from that of a higher animal. Nerve fibers ran from sensory centers into all sorts of unexpected places, branching and branching again, until anything like the simple reflex arc of the diagrams was out of the question.

It was all very confusing, until it was looked at from the developmental and functional side. The life of a hagfish is very simple and uneventful. Only two of its senses—smell and touch—are at all highly developed, and its only response to any kind of stimulus is a wriggle involving its whole body. Each stimulus that comes in, therefore, must be transmitted as an order to move to muscles all over the body. Hence the apparent random branching of the nerves, and their distribution in a seemingly ''haywire'' pattern, for fibers from this whole pattern converge into the muscles, always with the same response—a wriggle.

The nerves are not a set of separate signal wires, strung from one part to another to satisfy new and unheard-of needs. They arise more as though an originally single telephone line could branch into a party line as the family it served grew up and moved into several houses, continuing to serve them and flexibly adapting itself to the increasing number and complexity of their needs.

The separate reflex arcs as we see them in a human body stand, not at the beginning, but at the end of this process of development. From the beginning of animal evolution the body behaves as a whole. At no stage of development is behavior carried on by a number of separate or detached reflex arcs.

PARROT FEVER

THE only cases of parrot fever or psittacosis have been reported among pets in homes or shops. The only human cases have occurred as a result of intimate contact with infected birds. Many people who keep parrots and other birds make a custom of feeding their pets from their own mouths. The histories of cases of psittacosis in human beings all show that the sick parrot had been handled and fondled by the persons who subsequently became ill. In a case reported in England, the bird's mistress, in order to keep her sick pet warm, allowed it to sleep under a woolen jacket against her breast.

However, no danger of infection seems to exist unless there is this direct contact. Consequently, Dr. William M. Mann, director of the National Zoological Park at Washington, D. C., said it has not been considered necessary to close the parrot room to visitors, even though several cases of psittacosis have been reported in nearby Annapolis. Dr. Mann added that the disease had never occurred among the parrots of this zoo, where it would surely have been detected as post-mortem examinations are made of all the birds that die there.

Dr. Mann was not able to give any reason why parrots in zoos should be free from this disease when parrots destined to become pets occasionally have it. The disease is caused by a germ which attacks the birds infrequently, it appears. So far, it has not attacked any birds in the zoo. Scientists are not agreed as to the exact germ causing the disease. There seems to be considerable evidence that it is the *Bacillus psittacosis*. Some authorities think the unsanitary conditions under which birds are kept on the journey up from the tropics may have some relation to the development of the disease.

So far it has not been a serious enough menace to warrant placing quarantine restrictions upon parrots. There is a considerable profit in the sale of these birds. Exact figures on parrot imports are not available, but according to the Department of Commerce, 65,319 live birds other than song and game birds, and valued at $5 apiece and under, were imported from South America in a year. The value of these imports was $127,156. Be-

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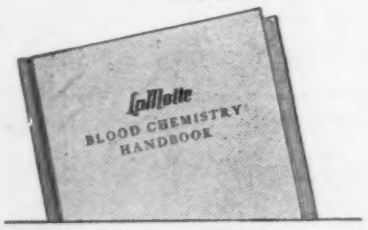

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sides parrots, this included cockatoos, love birds and parakeets. Of birds valued at over $5 apiece, there were 1,592 imported, at a total value of $26,870.

When human beings contract psittacosis, they have the symptoms of pneumonia and also of typhoid fever. They suffer from extreme weakness, high fever, a cough, nausea and intestinal disturbances. The disease is fatal in 35 to 40 per cent. of the cases. Some authorities think that the patients actually have pneumonia, that the parrot has simply weakened their resistance and made them more susceptible to pneumonia. The disease in the parrots is confined to the digestive system, but in man it is localized in the lungs.

An English authority, Dr. A. P. Thompson, of Birmingham, thinks the disease is perhaps not so very rare, but that a number of cases of it may occur which are considered to be some form of pneumonia or typhoid fever, particularly if the fact of a sick parrot in the household is not known to the physician. This was almost true of one case which Dr. Thompson attended. He was kept from a mistaken diagnosis in this case by the insistence of the patient's niece that her aunt had what the parrot had had.

The first case of psittacosis was reported from Germany in 1879. An epidemic of the disease occurred in Paris in 1892, at which time parrots had been very fashionable pets. Since then cases have occurred at intervals particularly in Italy, France and Germany, with only a few in England and the United States. During the last year, reports of cases have been more frequent in Europe and South America. An outbreak is now reported from Germany.

PREHISTORIC INDIAN HOUSE IN MISSISSIPPI

THE complete plan of a big circular Indian house has been excavated in a cotton field in Mississippi, is the announcement made by Henry B. Collins, Jr., of the U. S. National Museum. Mr. Collins, who has just returned from Mississippi bringing a drawing of the house plans, said this is the first discovery showing clearly how the prehistoric Indians of the Southeast designed their buildings.

The house, which is in the frequently plowed cotton field of Claude Pepper near Deasonville, was recently recognized as an Indian site when bones and potsherds were dug up by two young men working for the Mississippi Department of Archives and History. These men, Moreau Chambers and James Ford, invited Mr. Collins to work with them in excavating the site.

The house plan shows three circles of post holes which were used for roof supports. The outermost circle is sixty feet in diameter. Tracing the circles with a string, as the Indians probably did in the first place, the archeologists found that the circles were perfectly laid out. The Indian house builders dug the three circles in shallow trenches and set the posts firmly two feet deep within the trenches. The wall of the structure was very likely of wattle-work of reeds plastered with clay. Traces of a fire pit were inside the house, and also a square of post holes which provided additional roof supports and possibly set off an inner room.

The outermost trench was filled in with kitchen and household refuse, including bones of deer, bear, and smaller animals, fish jaws, clam and mussel shells, arrow points, bone scrapers and awls, one pipe and much broken pottery. Some of the pottery is a red and white kind heretofore found only in Arkansas. The trash of an Indian settlement was usually piled in a heap, and it is difficult to account for this use of it to fill the trench. One headless skeleton was unearthed in this trench. The tribe of Indians who built the house is not yet known. It is possible that this was one of the Mound Building tribes, for several mounds rise above the fields within half a mile of the round house.

ITEMS

AN engineering memorial to George Washington, the engineer, which would include the restoration of canal locks at Great Falls on the Potomac, is being sought by the American Engineering Council. It is proposed to complete the reconstruction by 1932 when the George Washington bi-centennial will be held. Washington's canal at Great Falls, a few miles west of Washington, is remarkable when the crude machinery he had to work with is considered. The canal on the Virginia side of the river is cut through rock for a distance of 40 feet at the lower end. As first laid out it consisted of five locks which took care of a 76-foot fall.

A NEW German invention, making it possible to bring a seaplane from the ocean surface to the deck of an ordinary passenger liner with a minimum of danger and inconvenience is described by Martin Grell in a report to *Die Umschau*. It consists of a runway of sailcloth which can be unrolled from the stern of the ship and trailed in the water, allowing the plane to climb upon its lower end, whence it is pulled to the deck by a winch. The canvas is kept taut and its lower edge held beneath the water by a suitable drag. With the ship steaming at a reduced speed of from five to seven knots, the runway is rigid enough to support an ordinary plane and five men.

THE United States has 350 cities in 36 of its states where there is at least one habit clinic to which problem children may go to have their troubles understood and adjusted, the U. S. Children's Bureau has found as a result of a check-up on the increase in these child guidance institutions. The bureau has recently issued a pamphlet directory listing the 500 psychiatric clinics for children in this country, thus showing the available resources in any given locality. It is only twenty years ago that the first clinic for the study of delinquent children was set up in connection with the Chicago juvenile court, Miss Grace Abbott, chief of the bureau, stated in comment. The number to-day is still insufficient to meet more than a small fraction of the needs of delinquent children and the needs of the children who are serious failures at school or who suffer from timidity and other personal handicaps.

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SCIENCE NEWS

Science Service, Washington, D. C.

COSMIC RAYS

THE cosmic rays, penetrating radiations that come into our ken from somewhere outside the solar system, may not be radiated waves at all, results of the latest experiments indicate. In a communication to the German scientific journal *Forschungen und Fortschritte,* Dr. Walther Bothe, of Berlin, and Dr. Werner Kolhoerster, of Potsdam, state that they have evidence that they are really high-velocity particles like beta rays, which are free electrons moving at high speed, or possibly like alpha particles, which are the stripped nuclei of hydrogen or helium atoms.

The two German physicists obtained their results with a specially built adaptation of the physical instrument known as the electron counter. It consisted of a cylindrical chamber, within which was a very slender oxidized wire, connected to an electroscope. Whenever a charged particle—electron or alpha particle—made contact with the wire the electroscope registered the impact.

Using two of these instruments, one above the other, within a lead-armored vessel to keep out the earth-originated radiations, Dr. Bothe and Dr. Kolhoerster frequently obtained coincidental registrations of particle impacts on their electroscopes. These they regard as having been due, in most cases, to the same particle striking both wires in succession. This would indicate that the particle came from above, with sufficient velocity to carry it through the lead armor and both tubes.

The possibility that cosmic rays may consist of moving particles instead of mere waves of energy is admitted to have radical implications by the two experimenters. To carry such particles through the resistance offered by the earth's atmosphere would require a starting velocity imparted by a potential of at least a billion volts. On the other hand, the total energy of the bombardment that reaches the earth is small, for the measurements indicated only one impact per second for every square centimeter of exposed surface. Considering the almost infinite minuteness of beta or alpha particles, this sinks to almost immeasurably small quantities.

The possibility that cosmic rays may be penetrating particles rather than true radiations receives some support from work done at the U. S. Bureau of Standards by Dr. L. F. Curtiss. Dr. Curtiss has used a different method from that employed by Dr. Walther Bothe and Dr. Werner Kolhoerster, the German physicists who report their belief in the particulate nature of the rays. He states that his results lend some support to the opinion of his German colleagues, but he is not yet satisfied that either the German work or his own constitutes full and conclusive proof. The technical report of Dr. Curtiss' experiments will be published in a few weeks by the Bureau of Standards.

ARTIFICIAL LIGHTING FOR HEALTH

A NEW era of artificial lighting, in which the importance of illumination as an aid to health as well as to vision will be considered, has now dawned, Dr. M. Luckiesh, director of the General Electric Company's lighting research laboratory at Cleveland, told the American Institute of Electrical Engineers meeting in New York City. The first great era came with the beginning of artificial lighting with the burning of crude materials, he explained, and the second with the use of electricity in arc and incandescent lamps.

"This dream of simulating sunlight," said Dr. Luckiesh, "and dispensing whatever health benefits there are in midsummer sunlight, while providing light for vision, has its beginning in the impressive logic of sunlight as a powerful environmental factor. It has been stimulated by some sound scientific facts which have been unearthed during the past forty years. It has not been influenced by the recent craze for ultra-violet radiation proclaimed as a cure-all by charlatans or others who profit blandly or blindly in the twilight zone of knowledge.

"No attempt will be made to marshal all the major scientific facts which emphasize the value of sunlight. Admittedly, these are far outnumbered by vague data and unsupported claims. Sunlight does cure and prevent rickets; therefore, it is important to the health of children. In some places the death-rate is highest in or shortly after the season when the sunlight is at its minimum. There is some evidence that fewer colds are experienced by a group of persons systematically exposed to artificial sunlight than by a group not exposed. Sunlight is closely related to one or two vitamins—possibly to all. The effect of a single exposure to powerful ultra-violet radiation for only a few minutes can be detected for two and sometimes three months after. The possible benefits of sunlight outdoors are intricately interwoven with those of exercise and fresh air. However, few intelligent persons would insist that sunlight is not beneficial.

"These are examples of facts having sound or only partial foundations. But beneath all this is the powerful logic of sunlight as an environmental factor upon which all life depends directly or indirectly. It has been bathing this earth since the most primitive life began. Plants have developed under its heat and light. Eyes have evolved to see by its energy of certain wave-lengths. Vitamin D at least is manufactured by it. Thousands of photochemical reactions selectively utilize its energy of various wave-lengths. Viewing the completed picture of which the foregoing is only fragmentary, is it possible to believe that sunlight—so interwoven into life-processes—is not directly beneficial to human beings? Is it not easy to suspect that its benefits extend far beyond present knowledge and even far beyond the ability of our imagination to encompass at the present time?"

Dr. Luckiesh described a new sunlight lamp that has been developed in his laboratory that closely simulates sunlight, both in color and health-giving powers. It gives light in three ways. At the bottom of the bulb is a little pool of mercury. When the lamp is turned on,

The Journal of General Physiology

EDITED BY

W. J. CROZIER JOHN H. NORTHROP W. J. V. OSTERHOUT

Contents of Volume 13, No. 3, January 20, 1930:

BORSOOK, HENRY, MACFADYEN, DOUGLAS A., AND WASTENEYS, HARDOLPH. The substrate in peptic synthesis of protein.

BOOR, ALDEN KINNEY. A crystallographic study of pure carbonmonoxide hemoglobin.

MOELWYN-HUGHES, EMYR ALUN. Note on the variation with temperature of the relative rates of hydrolysis of glucosides.

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the tungsten filament glows, and the heat vaporizes the mercury, then a mercury arc is formed between two tungsten electrodes, so that about 68 per cent. of the light comes from the glowing electrodes, 25 per cent. from the arc and the remaining 7 per cent. from the filament. The lamp is simple to use, though it requires a transformer to step down the ordinary lighting current to the 11 volts on which it runs.

This lamp, declared Dr. Luckiesh, is 50 times as effective in producing tanning of the skin, known medically as erythema, as midday midsummer sunlight of equal intensity. The quartz tube mercury vapor arc, sometimes used for medical purposes, is 500 times as effective, he said, but has the disadvantage of requiring the user to wear goggles while using it, in order to prevent serious eye trouble. The new lamp, he said, requires no more caution than one would use with midsummer sunlight. Its bulb is of glass, which cuts out some of the shorter, and more harmful, ultra-violet rays, but passes those which have the most beneficial effect.

The intensity of midsummer sunlight is far greater than any amount of artificial light that can be reasonably used in the home, he said, and so it was necessary to make the new light more effective in producing physiological effects. However, he declared, it has yet to be proved that sunburn is a necessary forerunner of curative or health value of the rays. Experiments on animals have shown beneficial effects, in curing rickets, with an ordinary 50-watt tungsten lamp, without producing a trace of erythema. In general, however, the rays that produce sunburn seem to be of about the same wavelength as those of curative value.

MODELS AND PHOTOGRAPHS IN MOTION PICTURE STUDIOS

IMAGES of small models and photographic transparencies reflected in a mirror with part of the silvering scratched away are taking the place of huge and costly sets in European movie studios. At a meeting of the Kinematograph Group of the Royal Photographic Society of London Hans Nieter demonstrated the Schüfftan process of model photography. The method is also being applied in England.

Though models were used in the early days of the movies, it was not possible to photograph human actors easily at the same time. Then methods were tried of using small models in the foreground, close to the camera, while the actors were in the distance. To focus the nearby models and the distant actors at the same time, however, it was necessary to use a very small lens aperture, and this in turn required extra illumination. Somewhat similar was the method used in "Robin Hood," where the upper parts of the castle were painted on glass, and placed in front of the camera in such a way that they appeared to be a continuation of the lower parts, which were actually built.

In the Schüfftan process either transparencies, made from actual photographs, or models can be used. Instead of being in front of the camera, they are placed to the side. A large lens in front of them corrects for their closeness, and a mirror at an angle of 45 degrees reflects their image into the camera lens.

When the directors and technicians have decided on the effect they want, a model or transparency is made, and the part in which the actors will appear is made in full size, to correspond with the model. This is erected in front of the camera, and enough of the silvering on the mirror is scratched away to show it. Final adjustments make the lines in the set appear as a continuation of those in the model. Then from the point of view of the camera, the set and model merge together imperceptibly. Because of the large correcting lens, everything is in focus, even with the largest aperture camera lenses, so that ordinary lighting can be employed.

In his demonstration Mr. Nieter showed one film of a train dashing over a wrecked bridge into a stream, with the escaping steam rising from the locomotive, and people actually swimming away from the wreck. All the parts of the train were in model form, while the people swam in a tank on the studio floor. Still other effects can be obtained with the use of several mirrors, to show, for instance, the workings of a man's mind, with various thoughts appearing for a time.

The method is particularly advantageous for the talkies, Mr. Nieter pointed out, because it permits the making of scenes in a small compass, and so avoiding the bugbear of echoes on a huge set.

AN AUTOMATIC COLOR-MATCHING MACHINE

A MACHINE that writes a permanent record of a color in ten seconds, and does it so accurately as to distinguish between colors so similar that they appear identical even to the trained eye, has been perfected by two young physicists at the University of Pennsylvania. Joseph Razek and Peter J. Mulder, both instructors in the department of physics, developed the machine as a by-product of a more abstruse research in which they were engaged while working for their doctors' degrees.

The heart of the machine is a spectroscope that analyzes the color to be studied, while its eye is the same magic lamp that has made possible both talking movies and television, the photoelectric cell.

Completely enclosed in a box the size of a large suitcase, there is a rectangular opening at the top over which the color is placed, which may be on paper, cloth, or any other material. A bright light shines on it, and is then reflected through prisms of the spectroscope, which spread it out into a rainbow-like spectrum, showing all the component colors.

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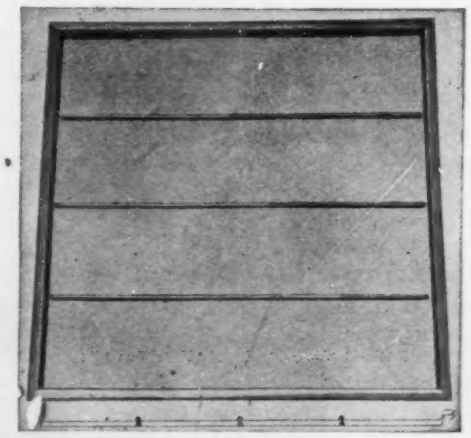

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REMAINS OF AN ICE AGE RHINOCEROS IN POLAND

THE complete body of an Ice Age rhinoceros, with muscles and skin complete and in place, has been dug out of the soil of Poland, in the district of Sarunia, Tytus Filipowicz, Polish Minister to the United States, has informed *Science Service*.

The finding of so complete a specimen of the Pleistocene rhinoceros is wholly unprecedented. Rhinoceros bones are fairly common fossils in Europe, for the great woolly animals ranged freely over the continent during intervals between glacial advances scores of thousands of years ago. Cro-Magnon artists sketched and sculptured its likeness on the walls of their caves. But of the non-bony parts nothing had been discovered before, except a few pieces of skin.

The present find was made as a result of renewed digging in a mine that had yielded the incomplete skeleton of a mammoth and the skull, foreleg and a large piece of skin from a rhinoceros, something over twenty years ago. Last year the Polish Academy of Science obtained funds for further excavation and went to work again, in spite of the fact that the old narrow pit had become dangerous due to the accumulation of oil on its sides and a tendency for poisonous gases to accumulate.

The digging revealed much new material of interest in the study of prehistoric plant and animal life of the region, and at last the sensational find was made of the complete rhinoceros. Premature and unauthorized reports gained currency that the find consisted of the skeleton of a mammoth, and the scientists in charge decided to let the rumors go on, thereby avoiding interruptions in the work by crowds of uninvited guests.

Confronted with the task of getting the giant animal out of the narrow pit, the committee called upon the Polish army for man-power. Soldiers enlarged the pit to four yards square by thirty-four yards deep, and through this new shaft the great carcass was raised to the surface.

It has been taken to the physiographic museum of the Polish Academy of Science in Krakow. It is planned to remove the hide and make a thorough anatomical study of the muscles and other organs, after which the skeleton will be mounted and placed on display. It will be the only complete Pleistocene rhinoceros skeleton in existence.

The Sarunia Research Committee, which brought the work to its successful conclusion, consisted of Professor K. Kostanecki, president of the Polish Academy of Science; Professor S. Kutrzeba, secretary of the academy; Professor H. Hoyer, Professor S. Kreutz, Professor J. Nowak, Professor W. Szafer, Professor J. Stach, Professor J. Morozewicz and Professor J. Tokarski. Immediate supervision of the work was entrusted to E. Panow, who cooperated with the present owner of the mine, Mr. Lautman, in clearing the rubbish away from the old diggings and in opening a new fifty-yard drift.

ITEMS

"IT is no longer sufficient that our highways be wide and smooth, they must also be pleasing to the eye," according to the men who design and build the roads at the annual meeting of the American Society of Civil Engineers at New York recently. "The growing appreciation on the part of the highway engineer of the esthetic phase of his work and the definite improvement that may be made by choosing road locations so as to bring out the natural beauty of the locality" were pointed out as outstanding developments in highway engineering during the past year. Sweeping curves, short tunnels to preserve mountain beauty and bridges that harmonize with the landscape are some of the ways in which the highway engineer is building with more beauty.

THE Schwassman-Wachmann comet, discovered by two German astronomers on November 15, 1927, is still under observation. Dr. Walter Baade, at the Hamburg Observatory, detected the comet on the night of December 21, 1929. Then it was of the 15.5 magnitude, far too faint to be seen except with a large telescope, but only about a magnitude and a half fainter than when it was discovered. Since then the discoverers, at the University of Berlin Observatory at Berlin-Babelsberg, have discovered another comet, which is also still in sight.

MINERS can now recover for the first time practically pure copper directly from sulphide ores by a method just discovered after a year's research by the school of mines and geology at Washington State College at Pullman, Washington. The method requires cheap hydroelectric power. Present methods of recovering copper ore involve smelting and electrolysis is used only to refine the metal. Only one previous attempt, made some 15 years ago, at obtaining practically pure copper directly from the ore by electrolysis was found in the historical researches undertaken. The details of the method will be published by the college.

THE world's stock of Neanderthal remains has been increased by a skull, recently unearthed in a quarry on the northeastern outskirts of Rome. The find is reported by a young Italian scientist, Professor Sergio Sergei. The skull is that of a woman, very closely similar in type to the original Neanderthal skull found at Gibraltar many years ago. Its brain capacity is the same, 1,200 cubic centimeters. While many stone implements of the type produced by the Neanderthalers have previously been found in Italy, this is the first find ever made of actual bones of this ancient, powerful, brutal-appearing but undoubtedly human species. In the same stratum of gravel with the new Rome skull were found the bones of an ancient elephant, a species of hippopotamus and the woolly rhinoceros, all of them animals that flourished in Europe during the warm period that intervened between the last two phases of the Pleistocene, or great Ice Age. The same formation has in other places yielded early stone age implements of characteristic Neanderthal workmanship.

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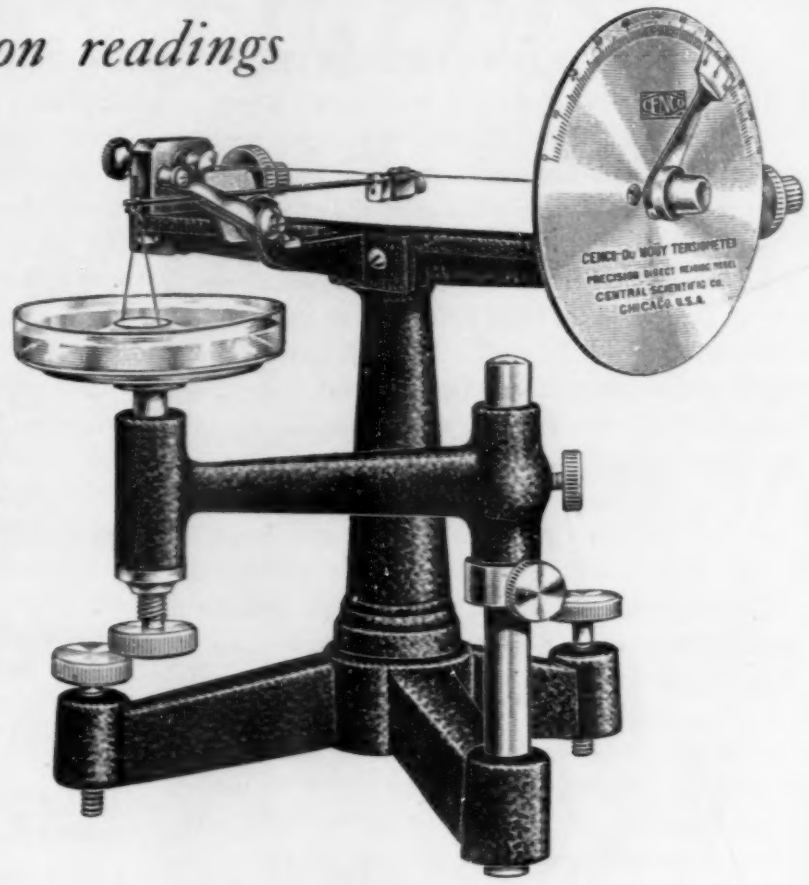

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PAPERS PRESENTED AT THE DES MOINES MEETING

DEFECTIVE individuals should not be allowed to reproduce and multiply the burden of their kind upon society, said Professor G. H. Parker, head of the zoology department of Harvard University, in the annual lecture before the Society of Sigma Xi and the American Association for the Advancement of Science. The great influence of heredity upon the characteristics of a person, brought out more strikingly than ever by recent scientific observations, should cause people to protect themselves at once from a great menace, Professor Parker said. "In experimenting on race betterment it seems quite clear that the place to begin is with the most defective members of society," he stated. "Those who are state wards and must be cared for by state funds, and those whose defects are hereditary, should in some way or other be restrained from reproduction. Such a step may be carried out by segregation, which has been advocated by many public custodians . . . , but a much more radical means of controlling defective individuals is sterilization. When sterilization is considered," he continued, "it is always easy for one to point out who should be sterilized. We all know the personalities about us who are objectionable, and we can quickly point out the stocks that should not reproduce. But sterilization is an operation that should not be allowed to proceed excepting in proper hands. It is an operation that should be permitted only through a court medically advised." California, with a eugenic sterilization law for about 20 years and more than 6,000 cases of legal sterilization, was pointed out as the most forward state of those that have adopted sterilization. The influence of organic inheritance has been greatly depreciated in the past, Professor Parker said, the belief being that people are influenced to a greater extent by environment. He recited a number of observations of identical twins, the only persons from whom information of this kind can be obtained, because they come into the world with exactly the same inborn characteristics.

RACE horses and men follow the same physiological laws in track events, and horses follow these laws more closely than men, is the conclusion reached by Professor A. E. Kennelly, of the Harvard Engineering School, as told in an address before the American Association for the Advancement of Science. Professor Kennelly has studied all world records for horses trotting, pacing and running and for men swimming, walking, rowing, running and skating, and he finds that there are certain definite relations between the time, distance and speed of all events for both man and beast. One application of what has been learned shows that if a man runs, or a horse trots or uses any of the other gaits over two distances, the first twice as long as the second, 118 per cent. more time will be needed to cover the second distance than was required for the first. Another of the laws shows how long an athlete may be expected to last before becoming exhausted if he increases or decreases his average speed. If his speed is raised one per cent., his running time is reduced nine per cent. Professor Kennelly said he also found that if the speed of a record event is increased 20 per cent., the record distance corresponding to the new speed is four and three tenths smaller than the first distance. These and many other interesting facts learned apply to all the different gaits given above and to a slight extent to bicycling and automobiling. They are valuable both to the scientist and to the athlete and sportsman and point out, especially for the athlete and sportsman, the most vulnerable records, those that should be most easily broken. The data for this study were secured by Professor Kennelly from the "World Almanac." Although he is an electrical engineer, he has made the determination of laws of fatigue of men and horses a hobby for a number of years, having published papers on the subject in 1906 and 1926.

JUST as one may sleep warmly out of doors under a quilt, or shiver under a sheet, so the upper atmosphere, what scientists call the stratosphere, is kept warm over Arctic latitudes by a thicker layer of ozone. This was the explanation for a curious fact that has puzzled scientists, in a paper read at Des Moines before the American Meteorological Society by Dr. W. J. Humphreys, of the U. S. Weather Bureau. The stratosphere is the layer of the atmosphere above the highest clouds, and, unlike the lower layers, does not become colder with height. Temperature observations have been made of this layer by means of small balloons, equipped with recording thermometers. They reveal the curious fact, said Dr. Humphreys, "that the stratosphere is coldest over equatorial regions and becomes gradually warmer with increase of latitude, the extreme difference being around 35 degrees Fahrenheit—coldest over the warmest earth and warmest over the coldest earth." Though a full explanation has not yet been made, Dr. Humphreys thinks that it is due to the ozone. Observations have shown that there is less ozone over equatorial than over Arctic regions, a fact that is itself yet unexplained. But the ozone absorbs radiation from the earth, and reradiates part of it back again. Therefore, where there is more ozone, more heat is sent back, and so the upper atmosphere there is warmest.

SEEN on any clear moonless evening after twilight as a faint beam of light in the western sky, the zodiacal light has long been an object of study by astronomers and physicists. At the meeting of the American Physical Society, held in conjunction with the American Association, Dr. E. O. Hulburt, of the U. S. Navy's research laboratory, suggested its connection with magnetic storms that sometimes affect the earth. Recalling observations made 75 years ago by a navy chaplain, the Rev. George Jones, Dr. Hulburt pointed out that most abnormalities

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of the zodiacal light, such as fluctuations, unusual brilliance or distribution over the heavens, followed magnetic storms. This, he thinks, indicates some connection, and suggests that the particles which cause the zodiacal light, by scattering light from the sun in some manner, originate in the atmosphere of the earth. The partly broken atoms high in the atmosphere may cause the phenomenon under the combined effect of the pressure of sunlight, the gravitation and magnetism of the earth.

BECAUSE of the number of animal diseases which may be transmitted to man, veterinary medicine is a necessary factor in the care of the public health. Four men who made outstanding contributions to our knowledge of disease, Jenner, Pasteur, Koch and Theobald Smith, are claimed by the veterinary profession because all of them were interested in animal diseases. So Dr. Pierre A. Fish, of New York State Veterinary College, said in an address before the medical science section of the American Association. Tuberculosis, undulant fever and tularemia are prominent diseases which are transmitted from animals to man, others being anthrax, glanders, foot and mouth disease, cow pox, rabies, actinomycosis, infectious jaundice, rat-bite fever and bubonic plague. For the control of these diseases public health officers and veterinarians must work together. Veterinarians contributed largely to the health of the army during the world war by careful inspection of all meat, milk and their products before consumption. The importance of continued study of the parasites of man and the lower animals was emphasized in a paper presented at the same session by Dr. Maurice C. Hall, of the U. S. Bureau of Animal Industry. Parasites may be transferred from one host to another, as from wild to domestic animals and from animals to man, and also in the reverse direction. The parasite in these cases seems able to adapt itself easily to the new host, but the host generally is not so adaptable and as a result shows evidence of hostility to the parasite which we recognize as a disease-picture. Veterinary parasitology is daily becoming of greater importance to the livestock industry, while human parasitology is still of major importance in the tropics.

"TOO much faith has been placed in our falling death rate from tuberculosis as evidence that this disease is under our control," Dr. William Charles White, of the U. S. Hygienic Laboratory, told members of the American Association. Complete conquest of this grave disease has not yet been made in spite of splendid advances. Over-confidence at this stage is to be avoided, especially because of the harm it may do by turning the public mind from this great task that still confronts the nation. There are still probably over 160,000 deaths annually from tuberculosis in the United States. Statistical figures of death rates give but one small phase of the picture. The rise of incidence of tuberculosis in young girls, studies of incidence of the disease in school children, such as those made by the Phipps Institute in Philadelphia, the appalling death rate from this cause among Negroes and Indians and the rise in the death rate in some cities in spite of valiant efforts being made all point to a task scarcely yet begun. Dr. White also described the scientific investigations being sponsored by the National Tuberculosis Association, which it is hoped will lead to complete understanding of the tubercle bacillus, its life history and chemical methods, and finally to its complete conquest.

BREEDING corn with as much attention to the pedigree of the individual plant as is now bestowed on the pedigree of the individual animal in horse or hog breeding will result in a great increase in midwestern farm productivity within the next ten years. This in effect was the prophecy made before members of the American Association and the American Society of Agronomy by Henry Wallace, editor of *Wallace's Farmer* and practical scientific corn breeder. He told of the methods of modern corn breeding, by which one can select qualities desired and put them into the new strain as a cook stirs ingredients for a cake together in a bowl, producing what might almost be called a synthetic corn plant. The work is done by inbreeding numerous strains of corn and segregating their offspring, until the tangle of their hybrid origin is unsnarled and the desired qualities remain as pure "unit characters." These inbred strains are used as the pollen-producers, or fathers of the new crop. They are planted among the rows of "mother" stalks, which are deprived of their tassels so that they can not produce any pollen of their own to contaminate the seed corn. The work requires both scientific understanding and the skill that comes with experience, so that it has proved most practicable to produce the new kinds of seed corn commercially on special seed farms and sell the product to the farmers, rather than have the latter produce their own seed, as they have been accustomed to do since pioneer days. But the result justifies the greater cost, in the opinion of Mr. Wallace, for although the work is hardly past the beginning stage and the new strains are as yet by no means ideal, they are already outyielding by about ten per cent. the old types of corn produced by open pollination. Mr. Wallace's paper was one of a series on the science of breeding as applied to corn, given under the leadership of Professor John B. Wentz, of Iowa State College.

XYLOSE, a sugar so rare that it has heretofore been a laboratory curiosity at $100 a pound, can now be turned out cheaply at a few cents a pound, requiring no raw material other than waste cottonseed hull bran, water and sulphuric acid. At the meeting of the chemistry section of the American Association for the Advancement of Science, Warren E. Emley, of the U. S. Bureau of Standards, described the process by which seed waste is changed into sugar. Xylose is different from its nearest neighbors in the sugar world, the hexoses or glucose type of sugars, in that it contains five carbon atoms to the molecule instead of six. Because it has always been so rare and expensive, it has never been possible to perform any extensive experiments with it, and consequently it has no known uses. But the experimental plant at Anniston, Alabama, can turn out a hundred pounds a day, and when larger units are built they will have an annual production of about a million tons of cottonseed hull bran to work on. So that if xylose has any uses it should not take long now to dis-

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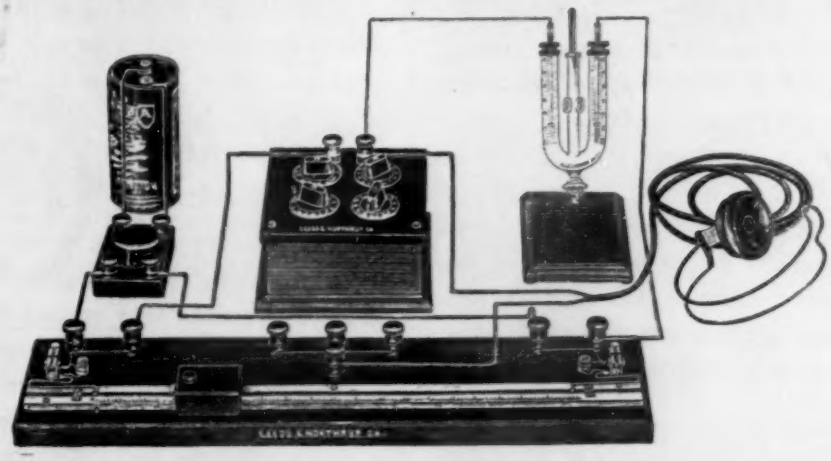

The above group of instruments is suitable for students' measurements of electrolytic conductivity with the Kohlrausch modification of the Wheatstone Bridge. This arrangement features our Student's Slide Wire with exposed circuits. It is unmistakably clear and simple, and is much used for elementary instruction. The resistance is high enough to produce a fairly symmetrical bridge.

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4203	STUDENTS' SLIDE WIRE	$30.00
4775	4-DIAL RESISTANCE BOX, 9 (1+10+100+1000) ohms	40.00
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4911-a	STAND AND CLAMP, for No. 4912 Cell	2.20
Total		$113.70

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cover them. Mr. Emley suggested that it might be used directly in food products, or possibly industrially as a raw material for alcohol, acids and other chemicals.

IT takes about half a second for the eyes to change from looking at a near object to a more distant one, Herbert H. Jasper, of the University of Iowa's Psychopathic Hospital, reported. By testing the time it took the eye to change from converging on one of three lights 17, 30 and 70 inches away in an otherwise dark room to one of the others, Mr. Jasper found that the average time on first trials varied from 557.1 thousandths of a second for the two nearest lights to 626.2 thousandths for a change from the nearest to farthest. A second set of measures showed improvement. Investigations of how the world looks to rats were reported by Professor Paul E. Fields, of the Ohio State University. The rat is supposed to have eyes which are not capable of discriminating forms, such as the triangle, Professor Fields explained. But in his experiments twenty-five white rats learned to discriminate between a triangle when the apex was pointing up and when the apex pointed down.

YOUNG oak trees must have plenty of sunlight if they are to develop strong root systems, Professor A. E. Holch, of the University of Nebraska, told the Ecological Society of America at its Des Moines meeting. He studied young burr oaks on an open hilltop, in an open stand of oaks and in a more densely grown stand of linden. Year-old seedlings in the full light of the hilltop developed a root depth of five feet and a total spread of 2.25 feet. Trees of the same age in the 12 per cent. light of the oak forest had a root depth of 1.6 feet and a spread of nine tenths of a foot, while in the shade of the lindens, where there was only a 3 to 4 per cent. light, the roots reached a depth of only eleven inches and had a three-inch spread.

ULTRA-VIOLET light is a stimulant not only to the health of humans but to the vitality of a microscopic fungus as well, said Dr. G. B. Ramsey and Mrs. Alice A. Bailey, of the U. S. Department of Agriculture, speaking before the American Phytopathological Society. It causes the production of more numerous and more vigorous spores in the organisms which give rise to the nailhead rust of tomatoes and Fusarium bulb rot of onions, two destructive diseases that attack vegetables while being shipped to market. As with people, the light will have a disastrous effect if too long an exposure is made.

A WELL-CONSTRUCTED office building has little to fear from earth vibrations caused by heavy traffic, Professor C. C. Williams, of the University of Iowa, told members of the association. Man's senses usually exaggerate the vibrations caused by street traffic, passing trains or rotating machinery. A movement of only one thousandth of an inch ten times a second seems a rather violent shaking to ordinary senses. Even the little street vibrations cause pictures to become askew on the wall and make dishes move because there is a more rapid movement in one direction than in the other.

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SCIENCE NEWS

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ELEMENT 87

WITH a method so delicate as to detect the presence of a chemical compound when dissolved in ten billion times its own weight of water, Dr. Fred Allison and Edgar J. Murphy, of the physics department of Alabama Polytechnic Institute at Auburn, Alabama, have located the unknown element number 87 in two well-known minerals. They will make a preliminary report of their research in the forthcoming issue of the *Physical Review*, the official journal of the Americal Physical Society.

Lepidolite, a form of mica, and pollucite, a mineral consisting chiefly of the elements caesium, aluminum and silicon, were the substances studied. As the properties of element number 87 are known in a general way, even though it has not yet been discovered, Dr. Allison and his colleague were able to predict its effect. Studies of the substances in four different chemical combinations all showed the effects that should be caused by element 87. This, say the experimenters, "affords evidence of considerable weight for its presence in the sample under test."

The next step will be to extract the element from the minerals, and when this is done it may truly be said to have been "discovered." Then only one unknown element will be left. According to modern conceptions there are 92 elements, numbered from hydrogen, which is number 1, to uranium, number 92. At present the series has two vacant spaces, one being number 87, to which the name eka-caesium has been tentatively assigned, and which is in the same group as lithium, potassium, rubidium and caesium. The other element is number 85, in the same group as fluorine, chlorine, bromine and iodine, known chemically as halogens.

About seven years ago there were six unknown elements. Then, in 1923, two Danish chemists, Coster and Hevesy, found number 72, which they named hafnium, after the Latin name for their city of Copenhagen. In 1925 Dr. Walter Noddack, at the University of Berlin, with the aid of two assistants, discovered numbers 43 and 75, which he named, respectively, masurium and rhenium. This was followed in 1926 by illinium, number 61, discovered by Dr. B. S. Hopkins, and named after the University of Illinois, with which he was connected. This was the first element discovered by an American.

THE SUN AND WEATHER FORECASTS

WEATHER predictions in the future must take into consideration variations in solar radiation, especially those eruptions noted in connection with sun-spots, according to William J. Rooney, associate physicist of the Department of Terrestrial Magnetism of the Carnegie Institution. Mr. Rooney has just returned on the Grace liner *Santa Barbara* from the Carnegie observatory at Huancayo, Peru, 12,000 feet above sea-level.

Observations made by him during his two months there are part of a series he is making throughout the world of the resistance of earth materials in order to check measurements of currents flowing through the earth.

"While there is still considerable scepticism among scientists as to the connection between weather and sun-spots," Mr. Rooney declared, "I believe that all those who have made a careful study of the available data are now agreed that there is a direct connection."

Mr. Rooney said that his work upon the resistance of earth materials had shown that certain solid substances, such as clay impregnated with magnesium salts, were better conductors of earth currents than sea-water, formerly considered one of the best conductors. The resistance of earth materials may vary from 100 ohms to 5,000,000 ohms per cubic centimeter within the same square mile.

This has an important bearing upon geophysical prospecting, he explained, for the variation in conductivity of earth materials enables the physicist to determine the depth of strata without boring or excavation by setting up electrodes in the earth's surface and measuring the resistance between them. He said he had determined the depth of surface water to within six inches by this method.

Measurements of the potential gradient of the atmosphere, he said, might vary during the day from 100 volts per meter positive to 50 volts per meter negative electricity. Although the potential is high there is very little current flowing so that it is difficult to measure. There is a continual radiation of electricity from the earth taking place, he said, but most of it is not lost. One of the most usual theories for its return is that it flows back in large quantities during thunder storms and in connection with ordinary precipitation.

CORONA DISCHARGES

MORE knowledge about the mysterious high voltage phenomena of corona, a source of great losses in long-distance transmission of electrical energy, was reported by Professor Sigmund K. Waldorf, of the Johns Hopkins University, before the winter convention of the American Institute of Electrical Engineers.

Professor Waldorf was most successful in measuring with very sensitive instruments the power losses caused by corona and in recording its wave form. The results of his experiments form a valuable addition to the present paucity of literature on the subject.

Ordinary metals like copper and iron are conductors of electricity. But even air will carry electricity if there is enough voltage or pressure to force it from one conductor to another. As the voltage or potential between the conductors is increased the air begins to undergo changes. First, there is a dark discharge; current actually passes through the air but it can not be seen. Then, with higher voltage, a glow is seen, and finally the discharge appears to be a number of sparks, called brush discharge.

Corona is manifest most on damp days when the conductivity of the air is great. Then it can be heard along

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high tension transmission lines as a loud humming, and the glow or brush discharge can sometimes be seen.

In his experiments Professor Waldorf measured the corona loss from a wire conductor in the middle of a copper cylinder. He found that the loss from the wire across a 12-inch air radius to the cylinder per foot length is 25 Watts, enough to light a small room.

A MATERIAL BOTH INSULATOR AND CONDUCTOR

THE discovery of a material that will prevent the flow of electricity at low voltages and allow it to pass at high potentials, reported by K. B. McEachron, General Electric engineer, to the American Institute of Electrical Engineers, gives the electrical industry a nearly ideal material for protecting its power lines from the great damage caused by lightning.

In normal times a lightning arrester of thyrite, the new material, will keep the current on the line. In storms, when lightning strikes, electricity will escape by way of the very arrester that so faithfully keeps normal power on the line.

Thyrite is a moulded compound including silicon carbide or carborundum. Figures on its relative cost compared with the cost of present types of lightning arresters have not been made public.

Each time the voltage across a piece of thyrite is doubled, the current increases 12.6 times. With practically all other substances current follows Ohm's law and is directly proportional to the voltage, so that doubling the voltage doubles the current.

Samples of the substance have a resistance of 50,000 ohms at 100 volts and less than half an ohm at 10,000 volts. They will carry lightning discharges as high as 30,000 amperes without any signs of distress.

The successful production of thyrite requires control of a large number of variables. The new material resembles black slate in color. It has mechanical properties similar to those of dry-process porcelain. In manufacturing, the material is moulded to the shape required and the contact surfaces are coated with metal by the Schoop metal-spraying process.

PLANT ROOTS AND DAYLIGHT

ROOT development in plants is seriously affected by the number of hours of sunlight per day to which the plant is exposed, just as the growth of stems and leaves is similarly influenced. Plants getting only half of the normal day of sunlight show less than half of the normal root growth. These results have been brought out in experiments reported to *Plant Physiology* by Professor J. E. Weaver and Dr. W. J. Himmel, of the University of Nebraska.

Experiments on the top growth and flowering habits of plants have been made by a considerable number of plant physiologists during the past few years, but up to the present no one has paid special attention to the possible effects of light duration on the parts of plants that never see the light. These effects, of course, are indirect, the results of what happens to the leaves aloft; but the studies of Professor Weaver and Dr. Himmel have shown them to be none the less pronounced.

Eight species of plants were used, in a very miscellaneous assortment: red clover, radish, iris, sunflower, dahlia, tall ragweed, oats and cosmos. Parallel lots of each were planted in two sets of large metal containers. One set was left outdoors to get the full benefit of the thirteen- to fifteen-hour days of May and June; the other set was kept in a dark house and wheeled out for only seven hours of sunlight a day.

In all cases the results were similar, so far as root growth was concerned. All of the long-day plants showed at least twice as much root growth at the end of seven weeks, and in some cases the ratio was four to one or more. Furthermore, the plants enjoying the benefit of the fifteen-hour sunlight day established a deeper "working level" for roots. That is, the region where the freest branching took place and where the plant did its most active work of gathering water and mineral nutrients from the soil was markedly deeper in the long-day than in the short-day plants.

WAR ON THE FRUIT FLY

THE first warm weather in the South will see a renewal of the warfare waged by federal and state forces against the Mediterranean fruit fly after its discovery in central Florida in April, 1929. Officials of the U. S. Department of Agriculture state that much the same methods of inspection and clean-up will be used this year, though the campaign will have to be more intensive and far-reaching because the success of last year's drive in reducing the number of the pests will probably make surviving infestations harder to locate.

So far as is now known, the outlying points of infestation discovered during the campaign of last spring and summer in Florida have been cleared of their last fly, and the area where the insect is likely to be seen again this year has been reduced to the territory where it was first discovered and where its initial development in this country probably took place. But federal entomologists do not feel that it will be safe to let these outlying areas go uninspected, because of the possibility of a few insects having overwintered in some hidden corner. A single female laying a batch of eggs could start one of these infestations all over again.

In spite of the fact that not a single fly has been seen in Florida since last fall, it will be necessary to have a full force of men in the original infested area when the breeding season returns. The pest hibernates invisibly within any one of a number of fruits and vegetables, and even a series of chill nights much colder than Florida experiences in the winter will not kill off all the brood.

The inspection force will need to be at work in the great peach belt of Georgia as well as in the citrus and truck regions of Florida. Peaches are just as fair game to the hungry grubs of the fruit fly as are oranges and grapefruit, and if the fly should once get started in Georgia it would not only work havoc in the peach orchards, but would be in a much more favorable position to begin a westward march than it now is, in its confined area within the Florida peninsula.

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Instructor in Economic and Soil Geography
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"'The Major Soil Divisions of the United States, is a pioneer work in a new field. It presents a systematic classification of the soils of this country, describes the characteristics of each of the soil groups, and points out their relation to agriculture. It centers the attention of the geographer upon an element of the physical environment that has been largely neglected in the emphasis on climate and relief. It gives an understanding of soils that should be a part of the equipment of every geographer. Dr. Wolfanger has made a valuable contribution to the field of geography."

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Geographic Relationships
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THIS book has two objectives: "to describe and explain the character of the great soil divisions of the United States and their sub-groups in terms of the principles and philosophy of modern soil science"; and "to describe and interpret these soils in their relation to our fundamental industries,—agriculture, grazing, and forestry."

This work will prove of value to geographers, geologists, agronomists, soil chemists, and many others in related sciences. The author has been actively engaged for many years as a soil surveyor for the U. S. Bureau of Soils, and has conducted considerable investigation in that field.

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EXPLORATION OF THE EVERGLADES BY AIRSHIP

A BLIMP, baby sister of the big airships, was added to the list of aircraft that have been used for purposes of scientific exploration when an official National Park Service party took the air from Miami for a reconnaissance flight over the proposed Tropical Everglades National Park area on February 11. This small type of airship is regarded as especially well adapted for this particular kind of flight, for it is less likely than an airplane to get into difficulties in case of engine trouble, and is wieldier and less expensive to handle than a big dirigible.

An aerial reconnaissance will save an immense amount of time in getting an estimate of the possible adaptability of the southern Everglades to national park purposes. Miami people who know something of the region say that it is possible to see as much from the air in one day as one could from the ground in several weeks.

The exploring party consisted of Horace M. Albright, director of the U. S. National Park Service; Arno Cammerer, associate director, and a group of scientists versed in various phases of tropical botany, zoology, ornithology, etc. They examined an area comprising approximately 2,500 square miles on the southern tip of Florida plus a number of small outlying islands. This land has been suggested as suitable for a national park. The party will make its report to the Secretary of the Interior, who may later be authorized by Congress to accept title to the land if it is offered as a gift to the United States. National the setting aside of public lands, as in the case of most parks are never created by Federal purchase, but only by of the western parks, or by the transfer of privately owned lands as a gift, as in the case of Acadia National Park and the new Great Smokies area.

The southern Everglades are of especial interest mainly because of the large elements of tropical life contained in their plant, insect, amphibian, reptile, bird and mammal populations. There are forms of life to be found here, especially on low coral-limestone ridges that rise in a sort of range, that exist abundantly across the salt-water channel in the West Indies but not to the north on the rest of the Florida mainland. Here can also be found the active geological processes of building up the land by corals, mangrove bushes and other agencies that turn water into land.

The area proposed for a new national park is almost wholly uninhabited. The Seminole Indians, who form a picturesque group in interior Florida, have their holdings to the north of this region, and their lands would not be disturbed. There may be a few of them, and possibly also a few white men and negroes, living within the area as squatters, but these could probably be compensated and removed without causing hard feelings or legal difficulties.

ITEMS

THE smallest of the U. S. National Parks, Sully's Hill Park in North Dakota would have its formal status changed to that of a national game preserve, by a bill introduced in the House by Representative Thomas Hull. The change would be, in effect, simply an official recognition of *de facto* conditions, because the area in question has never been used as a national park and has long been the site of an important game preserve. By transferring it from the Department of the Interior to the Department of Agriculture it is felt that the use for which it is best adapted can be better promoted. Sully's Hill National Park was created by an act of Congress in 1904. It contains one and one-fifth square miles, fronting on Devil's Lake. Mr. Hull's bill provides for the enlargement of the game preserve by the acquisition of not more than 3,000 acres to the east and south of the present area.

AFTER having photographed with the aid of an Army airplane and camera equipment prehistoric irrigation canals near Phoenix, Arizona, Neil M. Judd, U. S. National Museum archeologist, is now tracing upon the ground the ancient Indian engineering works that he discovered from the air. At altitudes of 2,000 feet, the old canals were often visible to the naked eye in cultivated fields that had been plowed over for many years. The best photographs were obtained at heights of 10,000 feet or more. Smoke and ground haze limited the useful flying time of the expedition to three hours or less at the middle of the day.

AN analysis of the electric spark completed in the physics department of the University of California by means of a camera whose shutter operates in one-billionth of a second discloses that during its brief life a 20,000-volt spark is 50 per cent. hotter than the sun and 100 times more bright. Using a special electro-optical shutter camera developed by Abraham Lemoine and J. W. Beams, of Yale, the experimenters were able to take what amounted to slow-motion pictures of the life of a spark at intervals of four one-millionths of a second, and to show how the appearance of a spark changes from beginning to end. The spark lasts only one hundred-thousandth of a second, but that would allow time for about 250 views at the time interval in which the camera shutter operates.

NEW methods of ventilating worked out by the U. S. Public Health Service may save thousands of workers in automobile factories from serious nose trouble, now often caused when accessories and trimmings on the car are treated to a coat of non-tarnishable chromium. Hydrogen, carrying a slight amount of chromic acid, is released in the plating process, Dr. L. R. Thompson, of the Public Health Service, explained to the House Committee on Appropriations, and if this passes a man's nose, it may be drawn up in the nose and be deposited on the septum. "If this continues, in a short time he loses the entire nasal septum. . . . Some automobile companies have tried ventilation, but the methods they were installing would draw the air straight up rather than across the vat. . . . We showed them that if they would draw the current of air across rather than up it would relieve the situation."

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SCIENCE NEWS

Science Service, Washington, D. C.

ATMOSPHERIC CONDITIONS FAVORABLE TO HEALTH AND WORK

PEOPLE work best when the thermometer registers between 40 and 75 degrees Fahrenheit. A temperature greater than 90 degrees in moist, still atmosphere would soon become unbearable. A pulse rate of 160 beats per minute indicates that the limit of endurance of atmospheric conditions has been reached.

These facts are indicated by experiments conducted at the U. S. Bureau of Mines in Pittsburgh to find the conditions of temperature, humidity and ventilation at which man can live and work best. They were described by Dr. W. J. McConnell, of the Metropolitan Life Insurance Company's Industrial Health Service, before the American Institute of Mining and Metallurgical Engineers meeting in New York on February 17.

Although conducted primarily to find means of increasing the comfort and efficiency of mine workers, the experiments will have many other practical applications, Dr. McConnell said. "They enable the engineer to predict how human beings will respond to certain temperature conditions and to suggest the most efficient system of combating exigencies of environment."

The possibility of controlling atmospheric conditions to treat such pathological disorders as nephritis, rheumatic infections, other forms of arthritis, certain skin troubles, superficial infections, and a variety of respiratory infections was also told.

"According to these researches," said Dr. McConnell, "the maximum amount of work was performed by those tested between the effective temperature limits of 40 and 75 degrees Fahrenheit. Subjects of experiments were capable of performing four times more work in a temperature of 100 degrees with a relative humidity of 30 per cent. than in a saturated condition of 100 degrees. For ordinary humidity of 60 per cent., the subjects did about five times more work in a temperature of 90 degrees than in one of 120 degrees."

An upper limit of man's ability to compensate for atmospheric conditions has also been established. When at rest or in still air, it was explained, this upper limit lies around 90 degrees saturated, or an effective temperature of 90 degrees.

But if an air velocity of two and a quarter miles per hour is introduced, the other conditions remaining the same, the upper limit is raised to 95 degrees. With increased air velocity, a still further shift results.

When ordinary muscular work was done, measured as 90,000 foot-pounds per hour, this limit was reached at 80 degrees.

"The observations further indicate that the pulse rate rather than the rise in bodily temperature determines the extent of discomfort experienced. When the pulse rate exceeds 135 pulsations per minute, the subjects complained of discomfort. They became restless and irritable and acquired a headache and palpitation of the heart. They became very thirsty; they noticed a metallic taste and spoke only with effort.

"The condition became distressing and unbearable after the pulse rate exceeded 160 beats per minute. Dizziness and confusion resulted, followed frequently by nausea, and numbness or soreness of the face. As the severity increased a feeling of 'floating in the air' was experienced, and it is probable that heartstroke would supervene if the exposure were continued. When the subject left the test chamber, . . . the pulse rate began to drop rapidly and his condition immediately improved."

The tests were conducted in compartments insulated by cork board. Fans, heaters, humidifiers, refrigeration equipment, distributing system and automatic control could hold any dry bulb temperature from 20 to 180 degrees, humidity from 10 to 100 per cent. and velocity from still air to 1,000 feet per minute.

EPIDEMIC INFLUENZA

IN spite of considerable effort to find the causal agent of epidemic influenza, the present time finds the problem still unsolved, Dr. Peter K. Olitsky, of the Rockefeller Institute for Medical Research, said in a De LaMar lecture which he gave recently at the Johns Hopkins School of Hygiene and Public Health.

There are several factors which contribute to the existing confusion, and the outstanding difficulty arises from the necessity of selecting cases of undoubted acute influenza. There has been in the past frequent failure to recognize influenza as a specific, primary disease, and therefore physicians and other scientists have failed frequently to consider as secondary infections the various bacterial pneumonias that develop in lungs injured by the influenzal agent.

Moreover the primary uncomplicated disease is usually mild and transitory; so that unless the cause is sought in the early hours it may become masked or even supplanted by associated organisms. Also, the rapid and extensive spread of influenza during pandemics makes it difficult to select for control observation cases of perfectly healthy individuals who have never suffered from the disease. Finally, to add to the confusion, a clear clinical distinction has not always been made between primary, uncomplicated epidemic influenza and many different types of upper respiratory infections, such as common colds, acute rhinitis, acute bronchitis and other indefinite conditions which may simulate a true influenzal attack.

Dr. Olitsky discussed three different agents which have been thought to cause influenza. Pfeiffer's bacilli have not yet been universally accepted as the causative agent, although there is considerable evidence to show that these organisms have some relationship to the cause of the disease. The same holds true for streptococci which have been implicated by several investigators since 1917, and most recently by Dr. I. S. Falk, formerly of the University of Chicago.

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Some investigators believe that the cause of influenza is a filterable virus free from bacteria of the ordinary species, or bacteria which can be cultivated artificially. Here again additional experimental evidence is necessary before a conclusion may be reached.

Dr. Olitsky and his colleague, Dr. F. L. Gates, have been studying the *Bacterium pneumosintes*. These are filter-passing bacteria found in the naso-pharynx of man. There are now reported in the literature at least 30 groups of pneumosintes-like organisms, mostly isolated by Drs. Olitsky and Gates and by workers studying in their laboratories. Dr. Olitsky drew attention to the fact that this germ was obtained only from cases of influenza. While there has been confirmation now and again of the occurrence of this filter-passing organism in influenza and not in other conditions, Dr. Olitsky said that he and Dr. Gates still maintain the cautious attitude they have previously expressed and prefer merely to present the experimental facts.

In conclusion, Dr. Olitsky is of the opinion that in view of the many workers engaged on the problem, it is likely that all obstacles will be overcome and an exact knowledge of the cause of the disease will be attained.

THE MUENCHEN DISASTER

WHEN the chemical cargo on the liner *Muenchen* burned and exploded at pier 42 in Hudson River, New York, there was added another chapter to the history of fires in which nitrates have played a part.

The *Muenchen* is reported to have had among its cargo quantities of sodium and potassium nitrate, chemical materials largely used in the making of fertilizers, explosives, nitric and sulphuric acids, dyes and many other chemicals. With the development of the fixation of atmospheric nitrogen on a large scale in Germany, that country has been a large exporter of these chemicals to the United States.

Nitrate does not burn in the sense that coal or wood does, but it does supply oxygen necessary for the combustion and it is therefore a great promoter of fire. Jute or other cloth bags used to hold the nitrate often provide the fuel for the fire while the nitrate supplies the oxygen. Shellac and peat moss are said to have been stowed in the same hold with the nitrate, and being highly inflammable they would have furnished fuel for the fire.

Paradoxically the worst thing to do to a nitrate fire is to pour water on it and therefore the firemen fighting the *Muenchen* blaze by conventional methods probably added to its fury. The molten nitrate is carried to fresh burnable material by the water and the chemical itself dissolves in the water with the generation of heat. On cars and warehouses in which nitrates are stored warning notices are often posted: "In Case of Fire, Keep Water Away!"

Dr. Charles E. Munroe, chief explosives engineer of the U. S. Bureau of Mines and a veteran investigator of explosions, declared that his researches show that "sodium and potassium nitrates present no fire hazard when by themselves and that to retain this security they should be stored and transported out of contact with combustible materials."

Other famous nitrate fires of history were recalled by Dr. Munroe. On July 19, 1845, fire originating in a five-story warehouse in downtown New York caused the destruction of 230 houses, with $2,000,000 property damage and many casualties, some fatal. Over a million pounds of merchandise, of which nearly 350,000 pounds consisted of Indian saltpeter (potassium nitrate), were stored in the building with the nitrate mixed indiscriminately among madder, raw silk, indigo, sugar, coffee, shellac and other combustibles. The final explosion wrecked the building and threw incandescent masses into the air so far that shipping in the Hudson River a quarter mile away was endangered. In May of the same year a ship, *Virginia*, loaded with linseed and saltpeter, exploded and sank 20 minutes after fire was discovered.

In recent years the records show that every few years a vessel carrying nitrates catches fire and usually the loss is total. As nitrates find large application in industry and are transported by rail, one or more nitrate fires on railroads are to be expected each year on the average. At arsenals and powder plants where nitrates are used in the manufacture of explosives, nitrate fires have also occurred, but storage of the chemicals in fireproof buildings of concrete and hollow tile has minimized the danger.

The *Muenchen* as an incoming vessel did not come under the jurisdiction of the U. S. Steamboat Inspection Service. The federal regulations require that on passenger vessels sodium nitrate be carried where it is readily accessible in case of fire and there is no danger of contact with water. Potassium nitrate must be carried as a deck load.

PRODUCTION OF TANTALUM

TANTALUM, the metal rarer than gold, which absorbs 740 times its volume of hydrogen gas, successfully resists attack by the strongest mineral acids, and changes alternating into direct current, is finding greater use for dental instruments, surgical tools, pen points, hypodermic needles and acid proof pumps, Professor George W. Sears, of the University of Nevada, reported to the American Institute of Mining and Metallurgical Engineers.

Even though tantalum was used for electric light filaments in 1906, until the past few years it has been only a rarity. It forms a much smaller portion of the earth's crust than gold. The production in 1928 was 35,000 pounds.

Because it absorbs gas so well, it is used for the metal parts of vacuum tubes. Although there are other substances which when used as an electrode of an electrolytic cell permit the passage of electricity in only one direction, tantalum is the best. Electrolytic rectifiers for charging storage batteries contain it. "Aqua regia, which readily dissolves both platinum and gold, has no action on this metal," continued Professor Sears. Hydrofluoric is the only acid successful in attacking it. Strong alkalies have no effect on it.

Tantalum can be cold-rolled to a sheet one thousandth of an inch thick. It is found in the Black Hills of South Dakota and in Australia.

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PUBLISHED in October, 1929, Gortner's "Outlines of Biochemistry" has received enthusiastic praise from prominent scientists in many fields. It is proving of unusual value to students and research workers in all the non-medical branches of the biological sciences. It represents the fruit of nearly twenty years of intensive investigation and research. Dr. Gortner is well-known both for his active study and experimentation with the problems of biochemistry and for his ability as a teacher and lecturer on the subject.

"There are seven sections to the book, the first of which, consisting of ten chapters, deals with the colloid state of matter. This section occupies almost 300 pages, and the author is particularly at home in connection with the colloidal properties of matter which are of greatest interest to biological students. The succeeding sections consider the proteins; carbohydrates and allied compounds; tannins; plant pigments; fats, lipides, and essential oils; and the biocatalysts. Following the 743 pages of text, there are general references to the literature of each section, an author index containing more than a thousand names, and an ample subject index, bringing the volume to 793 pages. Every chapter is replete with interest. The plant physiologist will be especially pleased at the amount of material that applies more or less directly to his field."

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PATENT FOR EXTRACTING RUBBER FROM GOLDENROD

MR. THOMAS EDISON has taken steps to protect his scheme for getting rubber out of goldenrod and other small plants by taking out a patent on the process. His new patent, just issued, bears the serial number 1,740,079.

The difficulty about getting rubber from such plants as goldenrod lies in the fact that most of it lies in the pith and in the cortex, or bark-like outer portion of the stem, while the bulky woody inner parts contain little or no rubber, yet clog up the extracting machinery and involve a lot of expensive handling of worthless material. Mr. Edison's process aims to get rid of this rubberless part of the stem.

In the process as described in the patent, the dried plants are first crushed between rollers, to open up the pith seams and break the bark. The crushed plants are then cut into pieces half an inch long and soaked in water. After this they are put into a water-filled ball mill. A ball mill is a device somewhat like a concrete mixer, which tumbles its contents over and over with a number of hard steel balls. This rapid pounding breaks the bark into small fragments, but shreds the woody part into fibers. After about an hour in the ball mill the contents are screened, separating the bark fragments from the fibrous inner portions of the stem. This mass can be used in paper-making or similar manufactures. The second stage of the process consists in grinding the separated bark and pith pulp in water and permitting the solid matter to settle in a tank. The rubber particles, being lighter than water, rise to the surface and are floated off.

Mr. Edison claims that this process is commercially practicable for producing rubber from goldenrods and other small herbs and shrubs. It is not known whether he actually intends to begin commercial operations using this process.

ITEMS

GOVERNMENT workers who do distinguished work along scientific lines would be rewarded with a medal of honor if a bill introduced in Congress by Representative Anthony J. Griffin, of New York, were passed. Recommendations for not more than five persons annually to receive this honor would be made to the President by a commission consisting of representatives of the National Academy of Sciences, the American Association for the Advancement of Science and the American Engineering Council. Upon presentation of the medal, which Representative Griffin desires to have known as the "Jefferson Medal of Honor for Distinguished Work in Science," the person so honored would receive one hundred dollars, and thereafter for the remainder of his or her life, an amount of money annually, of not less than one hundred nor more than five hundred dollars, "said sum to be exclusive of salary or pension." If the medal and award were granted posthumously, it would be paid to the wife or children or parents of the honored worker, with certain restricting and modifying provisions.

EUROPEAN travelers from New York will have a slightly longer trip beginning on February 15, for then the southerly route known as Track B will be in effect. This announcement is made by the U. S. Navy Hydrographic Office, following information received from the headquarters of the North Atlantic Track Agreement in London. During the fall and early winter Track C has been in use, but as icebergs and field ice are now moving down towards this part of the Atlantic, the southern track will be used. This year the ice is coming south much earlier than ordinarily, but this does not necessarily indicate that the ice will be unusually heavy later in the season. A still more southerly track, known as A, is sometimes used when the ice is particularly severe.

THE War Department has announced approval of plans for the construction of a highway bridge across San Francisco Bay to contain two cantilever spans, each 1,000 feet long. One span will allow a vertical clearance of 200 feet and the other 175 feet above navigable water. The bridge will join the city of Richmond and Marin County. It will be 17,769 feet long, nearly three and a half miles, including the approaches, and will contain 19 deck spans besides the long cantilever clearances. While the length of span of this bridge has been exceeded in other structures, it is unusual to have two such long links in the same bridge.

EVERY child will be its own danger signal, if the advice of specialists in home economics of the U. S. Department of Agriculture is followed by mothers. Protect your child by dressing it in vivid red, orange, bright blue or green that will attract the motorist's eye and prevent an accident when the child crosses streets or plays in the path of automobiles. Avoid inconspicuous dull coats of gray, brown, or navy blue.

A PORTABLE instrument which measures the intensity of ultra-violet rays by counting numbers on a meter was described to the American Institute of Electrical Engineers by Dr. N. C. Rentschler, director of research for the Westinghouse Lamp Co. The instrument makes use of a photoelectric cell with a uranium electrode which is sensitive to the ultra-violet rays that have the most healthful effect. The current flowing through it, which varies with the amount of light shining on it, charges a condenser. When the condenser, which holds electricity somewhat as a tank holds water, is filled, it overflows, or discharges, through a device known as a glow relay tube. This operates a relay, which in turn moves a counter up one number. To use the instrument, the operator simply opens it up where the light is to be tested, and takes the number of counts in five minutes. In bright sunlight, said Dr. Rentschler, there will be a hundred counts in this period, while for half the intensity there will be fifty. If a longer record is desired, the counter can be connected to another device, which automatically counts the number of discharges in each five-minute period over as long as thirty days.

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SCIENCE NEWS

Science Service, Washington, D. C.

RUBBER EXPERIMENTS

THE U. S. Department of Agriculture is watching the Edison-Ford goldenrod rubber experiments with interest, but is not carrying on any similar work of its own. The work is still in the non-commercial stage, and farmers are not being encouraged to put in a crop of goldenrod instead of corn or cotton next spring.

That Mr. Edison is really in earnest about finding some native plant that may serve as a source of home-grown rubber, at least in emergencies, is evidenced by the fact that he had a well-known New York botanist look over a vast number of plants. Over 1,200 potential rubber-bearers were examined and identified by this worker before Mr. Edison settled on the one species of goldenrod that is now engaging his attention.

Of the eighty or so distinct species in the goldenrod genus, only one has been selected as being the most promising of results in rubber. It is known to botanists as *Solidago leavenworthii,* and its range is restricted to a comparatively limited area in the Southeast. It would probably grow well over a much larger territory, however, if it should prove profitable as a crop plant.

Mr. Edison has informed the Department of Agriculture that even within the limits of this one species there is a wide fluctuation in rubber content. One lot of plants may yield as little as one half of one per cent. on a dry weight basis, another as much as six per cent. The problem then becomes one of selecting the best strain and endeavoring to improve it by breeding.

If goldenrod cultivation becomes commercially profitable, its propagation will not offer any serious difficulties. Almost all the species are perennials, sprouting freely from slender underground runners, and these rootstocks can be cut up in pieces to plant, like potatoes. Seed need not be used at all. In case a specially desirable strain of goldenrod should be developed, this vegetative propagation would be an advantage, for propagation by seed would permit such a hybrid to revert to its lower-grade ancestral condition, whereas planting by cuttings would keep it up to grade.

EMPLOYMENT TESTS

AN important psychological project which will personally affect the careers of thousands of boys and girls in the schools of this country is very soon to be put into effect, according to a report by Dr. L. J. O'Rourke, director of research of the United States Civil Service Commission. Dr. O'Rourke addressed a group of directors of research representing school systems throughout the country.

The federal government has joined hands with public school officials and industrial concerns in an effort to improve selection and placement procedures, and to prevent boys and girls from making false starts in finding satisfactory employment, thus lessening the number of misfits and cutting down an enormous economic loss.

A first installment of employment tests, now being perfected, will be released to high schools and colleges of the country in a few months. These first tests deal with stenography, typing, spelling, grammar and judgment. The tests will be used to determine the standards of ability which boys and girls who plan to enter office work must expect to reach. Later, tests for other occupations will be released.

"Results of the tests," Dr. O'Rourke explained, "will tell the pupil, as long before graduation as desired, to what extent he is prepared to meet actual employment conditions in industry or government. A prospective stenographer may learn, for example, that her stenographic speed is superior to that of 75 per cent. of stenographers in actual employment, but that her ability to use English is below that of 80 per cent. of successful stenographers. Information concerning her standing is an incentive when it is received by the student six months before the completion of her course; it may be depressing when it is received, as at present, at the employment office or on the job.

"The use of the standardized tests will make it possible for school vocational directors to recommend students in terms that will be meaningful to employers. Instead of using the vague terms of recommendation that are most common at present, they can tell an employer definitely that a certain girl has greater proficiency than 80 per cent. of the typists already in his employ."

Almost fifty industrial concerns, employing thousands of office workers, have already offered their cooperation with the project, the first ever started to bring together all the people concerned in this great problem of employment. Committees made up of outstanding educators and industrial leaders will aid in furthering the project.

Within perhaps a year, students will be provided with a sheet known as a guidance card, which will enable them to check up their ratings on the tests with the requirements for a great variety of positions. The Civil Service Commission is especially interested in this phase of the project, which will bring to the government service a more select roster of candidates, eliminating many who can foresee for themselves that they would not be successful in meeting government requirements. The guidance card will also work to prevent promising young people from entering fields where there is too little chance for advancement for individuals with their capacities.

STANDARDIZED DYES FOR GERM DETECTION

THE brightly colored dyes with which dangerous disease germs are stained to make them visible are in need of standardization, and this important task is now going forward under the auspices of a special commission, the Commission on Standardization of Biological Stains. Reliability of the tests for identifying disease germs depends in many cases on the quality of the aniline dyes.

Describing the progress of the investigation and the significance of the dyes in diagnosing diseases, the commission explains the way in which dyes are used to detect the organism that causes typhoid fever.

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If vacancies occur, students from other institutions desiring advanced standing may be admitted to the second or third year provided they fulfill the requirements and present exceptional qualifications.

INSTRUCTION

The academic year begins the Tuesday nearest October 1, and closes the second Tuesday in June. The course of instruction occupies four years and especial emphasis is laid upon practical work in the laboratories, in the wards of the Hospital and in the dispensary.

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Executive Secretary of the School of Medicine, Johns Hopkins University, Washington and Monument Sts., Baltimore, Md.

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No one cares to have his food handled by a person who carries living typhoid bacilli around with him, even though all clinical evidence of the disease in this individual may have been over months or years before. The detection of such "typhoid carriers" is assisted by certain aniline dyes. However, typhoid bacilli look almost exactly like certain other kinds of bacteria present in every one's intestines which have no relation to this disease. The similarity is so great that bacteriologists were at a loss until the use of dyes was discovered as a means of telling them apart. Several different dyes have been employed in this way, but the most interesting perhaps is the red dye, fuchsin.

If a jelly-like culture medium of the right consistency is prepared and this dye added to it just before use, the bacteriologist finds that only a few kinds of bacteria can grow on it, including the typhoid germ and one or two others. When the medium is properly prepared it is not red but a light straw color, for the dye in it has been reduced and is therefore decolorized. Now of the two kinds of bacteria most like the typhoid organism, one restores the color of the dye to a bright red, another to a light pink; while the typhoid organism itself does not restore the color. Therefore the places where the typhoid organism has grown on this medium are white; but the growth of the other organisms is colored. In this way the distinction can be made and it is possible by the use of this medium to tell whether a person is a typhoid carrier.

Unfortunately, however, not all fuchsins on the market work well in this test. Some do not allow the proper coloration of the ordinary intestinal bacteria; others are too red even before inoculation. Just why these different lots are at fault is a question that scientists have not completely answered. The manufacturer is unable, therefore, to furnish a uniformly satisfactory product, and the bacteriologist would be often inconvenienced in the matter except for the assistance of the Commission on Standardization of Biological Stains.

This commission is a private, non-commercial organization formed by certain scientists as representatives of various scientific societies. The commission has employed two different methods of standardizing the stains. The first is to determine the exact chemical nature of the dye satisfactory for any particular biological use and to furnish the manufacturer with such information. This is the ideal method and has been adopted whenever possible. In some cases a less satisfactory method of standardization has to be employed. The manufacturers have to submit samples that they think are all right, and members of the commission test them to see if they work. Approval is given only to those samples that are satisfactory and the manufacturer submits a new sample whenever it is necessary to make a new batch.

In this way it has proved possible to keep unsatisfactory lots of biological stains off the market. Now one can, for instance, buy a sample of fuchsin that has been approved by the Stain Commission, and be sure that it will work in the test above described for typhoid.

PROCESSES FOR MOULDING CLAY

PROCESSES of the oldest handicraft in the world, that of the moulder of clay, are being reversed to make from a useless earth paving slabs "more durable than concrete and cheaper than macadam," heat-insulated building walls, piling, sea walls, beams and foundations.

Through the centuries the potter has shaped his clay and then baked it. Professor Joseph B. Shaw, head of the ceramics department of Pennsylvania State College, bakes it first and then shapes it.

This new process which will employ vast deposits of formerly useless cyanite was described in a paper prepared by Professor Shaw and his son, Myril C. Shaw, and presented before the American Ceramic Society meeting in Toronto. But any clay now used in ceramics is adaptable to the process and will yield a superior product.

Professor Shaw has adapted the principles of processing steel to clays. He heats his clay to the point of vitrification, at which it will yield to shape under pressure. It it then rolled into the desired form or pressed into moulds and finally annealed at a lower temperature to permit the development of a strong crystalline structure.

Samples of reinforced blocks, the iron rods having been inserted after the clay was fired and before it was shaped, were shown. Other samples illustrated the reduction in size which takes place in the process, making a dense, tough article.

"The size of the article which may be made is limited only by the mechanical requirements. As far as I can see at present, eight by twenty feet is about the largest size practical now.

"This method," he continued, "has advantages over present processes in addition to opening the field to massive ceramic pieces impossible to make at present. It can be made entirely continuous, eliminating handling the material and utilizing mechanical equipment for complete handling from clay bank to the finished article in the stock shed. Fuels used are no more, probably much less, than used under present processes."

Warping and cracking which occur during drying and vitrification limit the size of articles that can be made by present methods. In the new process the article is not finally shaped until after drying and vitrification are completed.

Preheating is also the characteristic of the new process which makes possible the use of cyanite. Cyanite crumples to a powder when shaped and fired, but by being first fired and then shaped it can be handled like any other clay or shale. It is a pale sky-blue aluminum silicate and is found extensively all through the Allegheny Mountains.

THE TEETH OF ESKIMOS

ESKIMOS who have back of them countless generations of ancestors with strong jaws and perfect teeth are now, within two generations, undergoing radical dental changes, Henry B. Collins, Jr., of the Smithsonian Institution, has found.

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Vol. III: The vegetation of Mt. Desert Island, Maine, and its environment. By Barrington Moore and Norman Taylor. 151 pp., 27 text-figs., vegetation map in colors. June 10, 1927. Price, $1.60.

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Edited by **GEORGE SARTON**, D.Sc.

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SECRETARY: F. E. BRASCH
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Mr. Collins collected bones of ancient Eskimo dead and took physical measurements among the present living groups, this summer. He noted that Eskimo children and young adults around Nome and other white settlements showed much evidence of cavities in teeth, crowded teeth and sometimes extra teeth forcing their way into the dental curve. As he journeyed farther away from the white settlements and the handy grocery stores, he found that the tribes had more perfect teeth. The development of dental defects is attributed to the Eskimos' adoption of the white man's diet, in which cereal products and sweets are prominent. The Eskimos still eat some walrus meat, seal oil and whale blubber, but not enough to give their jaws strenuous exercise as in the old days, and they get much less of the proteins and fats and lime-containing foods than the strictly native diet contained. Teeth of elderly natives have not been affected by the change in diet, but suddenly the last two generations, which were born into homes using the mixed diet, are learning all about dental ills.

Whether the jaws of the Eskimos, long noted for their heavy development, are becoming smaller for lack of exercise and lime, which is bone-building material, is not yet clear.

Evidence that too much soft food and too little exercise for the teeth will affect a whole group of people is shown by Indian remains from the past. The Pueblos, who depended on corn as the basis of their food supply, had much more trouble with their teeth than had wandering plains tribes which hunted game for food.

ITEMS

CALIFORNIA fruit trees have escaped attacks of the Mediterranean fruit fly, but they are now menaced with danger of root rot, Dr. Karl F. Kellerman, of the U. S. Department of Agriculture, recently explained to the House Committee on Appropriations. This disease, which has hitherto been most damaging to cotton in Texas, has recently been discovered in the Department's experimental date garden at Indio, California. It apparently does not affect citrus fruit trees, but rots the roots of such trees as peach, almond and pistachio, and any of the deciduous fruit trees. California, which is on the verge of becoming an extensive cotton-growing state, is alarmed both on account of her fruit trees and her cotton. It is believed that nursery stock from Texas may have brought the root rot to the California experimental station, and government workers believe they can prevent its spread in California if they soak five acres of the experimental farm with disinfectant. The five-acre tract affected is now isolated from the rest of the farm with an earth and oil barrier. In Texas, where the fungus is wide-spread, no satisfactory method of treatment has yet been found which cotton growers can apply, though governmental and state agencies are constantly working on the problem.

A BILL to protect the American eagle has been reported to the Senate by the Agricultural Committee. According to the bill, killing, capturing, possessing, offering for sale or selling, purchasing or shipping this eagle, "the emblem of the United States," will be forbidden "except for scientific, propagating or exhibition purposes, or in defense of wild life or agricultural or other interests, as permitted by regulations of the Secretary of Agriculture." Any interference with the eagles' nests or eggs is also forbidden. The maximum penalty carried in the bill for crimes against the bald eagle is one hundred dollars fine or sixty days' imprisonment or both.

A GROUP of eleven American college students will undertake a large-scale search for Stone Age relics in the eastern part of Algeria, beginning early in February. The enterprise is known as the Beloit College-Logan Museum Expedition, and is under the direction of Dr. Alonzo Pond. The group will scatter itself over some 50 or 60 sites already located, and each man, with the aid of Arab workmen, will excavate his site until its cultural relationships to the whole are determined before moving on to the next. Half of the specimens collected will be sent to the state museum at Algiers. The other half will be the property of the Logan Museum at Beloit College and will be shipped to America.

TWINS, triplets, Siamese twins, quadruplets, all may get an especially cordial invitation to the Chicago World's Fair in 1933, if the plans of Dr. H. H. Newman, of the University of Chicago, are followed. Dr. Newman is a member of the biological committee which is planning science features for the exhibition. He believes that the fair offers a remarkable opportunity for science to get in touch with duplicate human beings. It is now realized that many problems of human physiology and behavior can be profitably attacked by study of human duplicates. Identical twins reared apart, for example, show in what ways environment does and does not alter an individual. Such separated twins are extremely rare. Dr. Newman advocates establishing a bureau of twin research, and he believes that if many twins and triplets come to the Chicago exhibit, they could be shown the importance of helping science with their cases.

DOUGLAS fir timbers, after 35 years of service, are not only equal to new timbers in strength, but are actually stronger, Professor E. H. McAlister, of the University of Oregon, found as a result of an investigation on material taken from Hayden Bridge, erected near Eugene in 1874, and recently replaced by a larger and more modern bridge. The timbers in the bridge were found to be in excellent state of preservation, and Professor McAlister's conclusion is that Douglas fir can be preserved in the sound structural condition for at least half a century by the simple expedient of keeping it covered from weather and providing for free circulation of air. More than 200 tests of the old timbers were made on machines which exert from 30,000 to 200,000 pounds pressure. For comparison, similar tests were made on both green and seasoned pieces of the same size.

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SCIENCE NEWS

Science Service, Washington, D. C.

EXPEDITIONS OF THE NAVAL OBSERVATORY

WHILE one of its offices is making last-minute calculations of the path of total eclipse of the sun visible in California on April 28, other astronomers at the U. S. Naval Observatory are preparing for an expedition to a remote island in the South Pacific to observe another total eclipse on October 21.

Niuafou Island, a tiny bit of land in the Tonga group, not far from Samoa, is the only accessible location from which the October eclipse can be seen. It is not much frequented by travelers, for the ordinary contact with the outside world for its few hundred inhabitants is a tin can full of mail thrown overboard by the monthly inter-island steamer. A native swims out and gets the can, which has given Niuafou the local name of "Tin Can Island."

Captain C. S. Freeman, superintendent of the observatory, stated to *Science Service* that, despite its inaccessibility, the Naval Observatory has decided to sponsor an expedition there to observe the eclipse. This will not be strictly a Naval Observatory expedition, however, for astronomers from various American observatories will participate. Dr. S. A. Mitchell, director of the Leander McCormick Observatory of the University of Virginia, and veteran of seven previous eclipses, will head the party.

The remainder of the personnel is yet to be selected, but Captain Freeman especially desires some astronomer who can make photometric observations of the brightness of the eclipse. If some one can be found who is willing and able to make such observations, he will be given a place.

Starting in the summer from San Francisco, the party will proceed to Pago Pago in American Samoa by naval transport, whence a smaller naval vessel will transport the party to Niuafou, several hundred miles distant.

April 28 will bring the year's first total eclipse, and this is also occupying the attention of the Nautical Almanac Office at the Naval Observatory. This eclipse crosses California, Nevada and Idaho, but is of very short duration, and not nearly as favorable astronomically as the one in October. It will only last about a second and a half at most, and the path over which it will be total, where the dark disc of the moon hides the sun, will only be about half a mile wide, as compared to a width of perhaps a hundred miles for a really good eclipse.

Eclipse predictions are always a bit uncertain, owing to incomplete knowledge of the moon's motion, and the skill of the astronomers will be taxed in locating the exact path in advance. Calculations now being made are taking into consideration observations of the moon made as recently as last month, and it is hoped that no astronomer who is guided by their predictions will find himself outside the path of totality.

FOSSIL SPECIES OF THE GRAND CANYON

FOSSIL remains of plants found in the walls of the Grand Canyon show that many millions of years ago stunted vegetation of very singular aspect grew in a great red sandy floodplain under a semi-arid climate in northern Arizona. This great red land has been found by David White, who has been studying the deposits and their remains of extinct plants for the Carnegie Institution, to have continued a long time before the region sank beneath the sea and was covered with the sea shell-bearing limestones hundreds of feet in thickness which form the upper part of the walls of the Canyon. These limestones pave the high plateau through which the canyon was and is still being cut, and they underlie the foundations of the hotels and camps on both sides of the great abyss.

Most of the newly discovered relics of this ancient growth represent seed-ferns. These were fernlike plants that bore real seeds instead of spores. The rocks that contain them, known geologically as the Hermit shale, were laid down as fine-grained river silts long before the Grand Canyon was even a crease on the surface of the desert plateau. They date from the Permian, the period immediately following the Coal Age.

Some of the plants are found in beds of the same geological epoch in eastern North America and in Europe as far east as the Ural Mountains. One unique group of forms is most closely connected with a flora that covered the region of tremendous glaciers in ancient times which spread over portions of India, Australia, South Africa and South America. Remnants of this flora should be found among the specimens of fossil plants which Professor Gould, of the Byrd Antarctic Expedition, may have found in the Queen Maud Range which he explored in Antarctica.

The thick layers of ripple-marked silt indicate that the rivers of the region at that time carried considerable volumes of water, at least part of the time. Some of them are marked with deep "suncracks" telling of the exposure of the mud to intense heat and rapid evaporation. The molds of salt crystals testify to seasons of intense drought, while, in addition to the impressions of raindrops, the deep pits and pockmarks on the surfaces of some of the shales bear record of hailstorms. All this argues a fairly dry though not necessarily arid region, visited by occasional though short-lived periods of rainfall, followed by "fair and warmer." The droughtiness of the ancient climate is also argued from the character of the leaves. Though most of these are fernlike, they are severely simple in outline, lacking the fine feathery subdivisions that mark such leaves when they grow in a moist climate. Many of them are fuzzy and their stems are covered with scales or fine spines, suggestive of desert growth. Some of them have thickened blades, and at least one species appears to have had the habit of curling into quills when it dried. All these characters earmark the plants of dry-air habitats.

Besides the fernlike plants, there are several curious forms of branches with twigs of stunted coniferous trees. All the different kinds found in the deposits became extinct many millions of years ago. Some of the genera and species have never been found in any other region.

National Research Council

National Research Fellowships in the Biological Sciences

Post-doctorate fellowships in the biological sciences (zoology, botany, anthropology, psychology, agriculture and forestry) will be further assigned by the Board of National Research Fellowships in the Biological Sciences for the academic year 1930–31 at a second meeting to be held about May 1st and 2nd. Applications are requested by March 20th; but must be filed by April 1st in order to insure consideration at this meeting. Appointments may be made prior to the conferring of the doctor's degree, to be effective upon the receipt of the degree within six months. Forms of application and statement of conditions will be furnished on application by letter or by wire to

The Secretary, Board of National Research Fellowships in the Biological Sciences, National Research Council, Washington, D. C.

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If vacancies occur, students from other institutions desiring advanced standing may be admitted to the second or third year provided they fulfill the requirements and present exceptional qualifications.

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Published October, 1929

This booklet, already quite well known among bacteriologists, has been completely revised. It has 224 pages (about 75 more than first edition), discusses about 20 dyes not covered in the old edition, and also gives in detail about 75 of the most important staining formulae and procedures calling for stains. This latter feature makes it a useful laboratory handbook.

The book is written by the Chairman of the Commission on Standardization of Biological Stains, and is published by the Commission. Price, $3.00, postage additional; or $2.75 postpaid if cash accompanies the order.

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With the remains of plants are associated wings of insects, trails of worms and large numbers of remarkably distinct footprints of different primitive amphibia, suggestive of the living "mud-puppy" and of reptiles. Some of the footprints are of rather large size; others are very small and delicate.

In naming his new species and genera, Dr. White has given recognition to local place-names and to persons associated with the Grand Canyon. The principal new genus is a seed-fern which he has called *Supaia,* from Supai, an old Indian name which has been applied to one of the rock formations in the Canyon wall. One species of this new genus has been named *Supaia merriami* in honor of Dr. John C. Merriam, president of the Carnegie Institution of Washington, and another has been called *Supaia sturdevantii,* in memory of a former park naturalist who was drowned in the river while on an exploring trip through the Canyon.

Two other new genera have been named *Yakia,* from an Indian place-name, and *Eltovaria,* in memory of a Spanish explorer of the Southwest. An animal genus of uncertain connection Dr. White has named *Scoyenia,* after Aven Scoyen, formerly chief of the ranger force in Grand Canyon National Park.

NATURE OF THE ZODIACAL LIGHT

STREAMING out from the earth on the side away from the sun there may be a sort of comet-like tail, which we sometimes see as a faint patch of light called the "Gegenschein" or "counter-glow." This is the suggestion just made by Dr. E. O. Hulburt, of the Naval Research Laboratory, in a report to the American Physical Society, on the nature of the zodiacal light.

This light can usually be seen on a dark, clear night after twilight has gone. It appears as a faint beam of light extending upward from the western horizon along the ecliptic, the path of the planets. In the spring, when the ecliptic is almost vertical in the evening, it can best be observed. Near the horizon it is brighter than the Milky Way. In the early morning, before dawn, it can also be seen, extending upwards in the eastern sky. The generally accepted theory of its origin, in recent years, has been that it is caused by sunlight reflected from a mass of tiny bodies, each moving in its own orbit around the sun. The "Gegenschein," seen in a dark night sky as a faint patch of light directly opposite the sun, was supposed to be due to a concentration of these small particles about a million miles from the earth on a line with the sun and the earth, as a result of the gravitational attraction of these two bodies.

Dr. Hulburt, however, revives an old theory, that the particles originate in the earth's own atmosphere. He points out that outbursts on the sun, which give rise to magnetic storms and displays of the northern lights, also affect the zodiacal light. On this account, he suggests, it seems as if the zodiacal light is not mere reflected sunlight, but that the particles themselves first absorb the light, and then re-emit it. Physically, this is quite a different process from reflection. According to Dr. Hulburt, collisions of atoms and molecules high in the earth's atmosphere cause some to be ejected from the influence of the earth with a speed of about seven miles a second. They reach levels of some 40,000 miles above the surface of the earth where they are partly broken into ions by the action of the sun's ultra-violet light. Here they are acted upon by three forces: the gravitational attraction of the earth, the magnetic attraction of the earth and the pressure of light from the sun. This arranges them into a ring, oblong in cross-section, surrounding the earth. It is this ring that gives off the zodiacal light, suggests the physicist.

The ring is perhaps 50,000 kilometers (31,000 miles) distant on the daylight side of the earth. On the night side the ring stretches out to great distances of 100,000 or 1,000,000 kilometers (62,000 or 620,000 miles). At its far end ions continually stream away in the direction of the sun's rays, so that the ring merges into a sort of comet's tail which may be the Gegenschein.

At the rate at which the atoms would escape from the earth, Dr. Hulburt estimates that about a millionth of the atmosphere would be ejected in a million years. He points out that one point which his theory does not explain is that about 15 per cent. of the zodiacal light is polarized, that is, the light vibrations are only in certain particular directions, instead of being indiscriminately in all directions, as in ordinary sunlight.

ARCHEOLOGICAL SURVEYS BY AIRPLANE

AN elaborate system of canals built by Indian engineers somewhere about 1200 A. D., and now almost entirely lost to view, has been successfully mapped by the penetrating eye of the airplane camera. The mosaic map of what might be called invisible ruins was made from a U. S. Army plane and by an army photographer. Neil M. Judd, archeologist of the U. S. National Museum, supervised the aerial survey over the Gila and Salt River Valleys, in Arizona.

Preliminary reports from the army officers reassure Mr. Judd that the photographs achieved their purpose, though the work of developing and arranging the negatives is not complete. The pictures were taken from an altitude of about two miles.

The magic ability of airplane photography to bring back into existence the plans of vanished buildings surprised the people of England when Major O. G. S. Crawford showed that his air pictures could record the plans of Roman towns and fortresses long since plowed over. Now, Mr. Judd has shown that the same magic works for America's prehistory.

Only forty years ago, the lines of 400 miles of the prehistoric canals and laterals could be seen in central Arizona. Now, not more than 40 miles of this remarkable engineering work can be observed from the ground. The land which the Pueblo Indians irrigated so that they could raise their corn, beans and squashes is now green with alfalfa, citrus and date groves, fields of lettuce and cotton. The Coolidge Dam stores water for much of this farming.

The plan to study the Indians' system of irrigating this region was proposed by Senator Carl Hayden, of

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Arizona. Last summer Senator Hayden noticed that where Indian reservation land was being prepared for irrigation the workmen were pulling up cactus, mesquite and other growth at the rate of twenty acres a day and filling in the ancient canals. He felt that some record of the old American engineering should be quickly made.

In many cases an airplane observer 2,000 feet up can see with his own eyes the course of the old canals. Describing these observations and his study on the ground, Mr. Judd stated that the engineering of the Indians was sound. Their ideas were so sound indeed that many of the modern canals of the region, dug with steam shovels, have followed the same contours and approximately the same gradient. The Indians had to dig their canals with nothing better than stone tools and sticks. The loosened material was carried off in baskets. They had no metal, no beasts of burden.

Both the Pueblos and modern engineers have followed the same course of constructing canals and later abandoning them in favor of new ones, Mr. Judd explained. From the air it was possible to find points where one of the early Indian canals was cut across by a later one.

White settlers who first went into the Southwest made good use of the Indian engineering plans. One Mormon group which settled near the town of Mesa in the eighteen-seventies dug a canal in one of the courses set by Indians many centuries before, and a part of that canal is in use to-day.

ITEMS

THE almost inaccessible natural bridge high up on the side of Bridge Mountain in Zion National Park may soon be within reach of the hardy hiker as a result of a successful climb to the top of the bridge by three men, Superintendent E. T. Scoyen, of the park; Chief Ranger D. J. Jolley, and Ranger A. G. Schiefer. The main purpose of the trip was to study the practicability of building a foot trail to the bridge site. It was found that such a trail can be constructed, but even under the best of conditions the trip will always remain one to be undertaken only by the more venturesome and hardy.

THE largest fish hatchery in the world is now under construction near Lonoke, Arkansas, according to the Arkansas Game and Fish Commission. The hatchery, a state project, is being built under the supervision of Del Brown, in charge of the U. S. Bureau of Fisheries station at Mammoth Springs, Arkansas, who has been lent to the state for the undertaking. This record-breaking hatchery will include 244 acres of ponds and will be devoted to the propagation of the warm-water nest-building fishes such as bass and bream.

YEAST that has had its chance to absorb the ultra-violet rays of sunlight has proved effective in keeping young chicks free from the disabling and often fatal disease of leg weakness, in experiments performed at the University of Wisconsin by Dr. Harry Steenbock, Dr. J. G. Halpin and Dr. G. E. Holmes. This disease, which is really a form of rickets, has been combated in the past by giving the chicks doses of cod-liver oil, but it is pointed out that irradiated yeast is cheaper, easier to mix with the ration, and less likely to leave undesirable flavors in the flesh of the young fowls.

JUST as crushed rock is mixed into concrete, so small pieces of limestone are added to molten bearing metal to form a conglomerate which is in successful use on tramcars in Germany. The theory of this revolutionary procedure is that the limestone acts as a sponge and absorbs the oil.

A NEW fossil species of ape, quite unlike any now in existence, has been turned up out of the marly soil of southern France, at Sénèze, in the department of Haut-Loire. The animal is represented by a skull in fairly good condition, with the lower jawbone and almost all of the teeth still intact. Professor Charles Depéret, of the University of Lyons, who has made a study of the skull, states that the animal was an old female. The skull has a length of seven and a quarter inches over all, and the width over the cheek arches, one of which is now broken, was about four and one half inches. The skull is remarkable for the great protrusion of the face, which almost parallels that of the modern baboons. Professor Depéret does not contend that the creature was an ancestor of the baboons, but cites the development of face and jaw as a case of "convergent evolution." In other respects the skull offers some suggestions of the snouted monkeys of Asia. Professor Depéret has named the new species *Dolichopithecus arvernensis.*

SUNSHINE and cloud, rain and snow, heat and cold, or humidity will not interfere with the work of the president of the United States and his staff upon the completion of the remodeling of the presidential offices in the White House's west wing, ravaged by fire on Christmas eve. Air-conditioning apparatus will refrigerate the air in summer, heat it in winter and keep its relative humidity at 50 per cent., most comfortable at all seasons. The outside air will be filtered and washed and admitted to the building through one inlet with all windows kept closed at all seasons. Ideal lighting is being designed for all offices and special attention will be given to President Hoover's own office and the Cabinet room, in which the lighting has not heretofore been considered adequate.

TURKEY-LIKE birds once nested in the region now occupied by the city of Los Angeles, California. This fact has been brought to light in the course of a review of the Ice Age birds of Rancho La Brea tar pits in the collections of the Los Angeles Museum. The review was undertaken by Dr. Hildegarde Howard, of the museum, for the purpose of establishing a census of the birds of the region. It was found that of about 500 individuals of the extinct, turkey-like bird, *Parapavo,* represented in these collections, more than 150 were young birds, many of them only chicks.

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SCIENCE NEWS

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INVISIBLE STAGES OF GERMS

SCIENTIFIC men have often been baffled in their search for disease germs because germs have a stage or stages of development in which they are too small to be recognized by microscopic examination, filtrable through fine filters and, for a time at least, non-cultivable by ordinary methods. This is the opinion of Dr. Philip Hadley, of the Medical School of the University of Michigan. Dr. Hadley, known for his studies on the transformations which bacteria undergo in artificial cultures and in the body, told a gathering of scientists at Ann Arbor that he had been successful repeatedly in causing disease-producing bacteria, appearing under the microscope and in cultures in the conventional form, to undergo dissociative changes which rendered them invisible, and filtrable through fine-grained earthen and porcelain filter candles. After further laboratory procedures these minute bodies were made to redevelop into the "normal" form. Sometimes weeks or months were required to effect this reversion.

Should Dr. Hadley's experiments and conclusions be correct—and it was admitted that it was more than possible that they were—a number of firmly held notions in present-day bacteriology would seem to demand some revision. This refers to such matters as valid criteria for judging the sterility of normal or pathological tissues and body fluids, criteria for judging when a bacterial culture was really dead, the true significance of so-called "bacteriolysis" and the bacteriophage phenomenon; also perhaps the biological relation between the filtrable forms of bacteria and some of the so-called filtrable viruses.

Dr. Hadley emphasized the need of studying bacteria not alone with reference to the ordinary form that is well known to bacteriologists and described in the textbooks, but also with reference to the other cyclostages in which the organisms may masquerade for a time, and in which form they are seldom recognized. One of the most important of these is the filtrable form which occurs in the G-type culture.

The speaker voiced the opinion that, contrary to the common belief, any bacterial species in its entirety is not so simple a thing that it can be revealed by a study of a single cell or a single culture; but that it is highly intricate in its cellular organization. This might be taken to mean that far more remains to be discovered regarding the complex biology of many "well-known" microbes than is already known by bacteriologists to-day.

MILKWEED AS A SOURCE OF OIL, FIBER AND INSULATION

MILKWEED, once considered as a possible source of rubber but long since dismissed, may yet become a useful crop plant, in the opinion of Dr. Fisk Gerhardt, of the Iowa Agricultural Experiment Station.

In a report to *Industrial and Engineering Chemistry*, Dr. Gerhardt shows that milkweed compares favorably with other plants of commercial value, such as flax and kapok. He reports a yield of 30 bushels of seed, 280 pounds of floss and one ton of air-dry stems per acre. He finds that its seeds are rich in oil, that its seed fibers are buoyant and do not absorb water readily and that its stem fibers compare favorably with hemp and flax.

Analysis shows that the dark brown seed of the milkweed is similar in composition to that of several of our crop plants. It contains 21.2 per cent. of oil, as compared with 19 per cent. in cotton seed, and 33 per cent. in flax seed. It is classified as a semi-drying oil. By bleaching it is possible to make it a clear, colorless product similar to various plant oils now in use as food.

The fibers just beneath the bark and along the outer surface of the woody stem are soft, pliable, almost white, and resemble flax very closely. This makes them potentially valuable as material for the textile industry.

The silvery white seed fibers of the milkweed plant have been called "the cotton of the north." All attempts to use them in the textile industry, however, have so far failed, as the fibers are rather brittle. Nevertheless they do have a low moisture absorption and a high degree of buoyancy. These specific qualities make them especially fitted for use in playground equipment, life savers and insulating materials. They resemble kapok in these respects.

"With the pronounced increase in our consumption of cellulose," Dr. Gerhardt says, "it becomes obvious that our future supply will of necessity originate in annual plants rather than in those plants requiring years to attain sufficient maturity, such as trees. In the development of future sources, the by-product return in the form of oils, gums, resins and protein concentrates will continue to be a factor of prime importance. The commercial demand for these latter commodities is gradually approaching in magnitude that of our cellulose industries. Among the primary problems now confronting the chemist and plant breeder are those concerned with further exploitation of our present cellulose wastes and the development of our most promising sources of fibrous materials."

BACTERIA FOR THE EXTRACTION OF PLANT OILS

TINY bacteria may replace ponderous iron presses in the work of extracting vegetable oils from many varieties of seeds and nuts. This is the suggestion of John Woods Beckman, an Oakland industrial chemist, made in a report to the American Chemical Society.

Vegetable oils are held in microscopic cells in plant tissue. The walls of these cells are composed of tough cellulose. The pressing of vegetable material for oils means crushing these cell walls. Exceptionally tough cell walls often offer so much resistance to pressure that extraction of fat is far from complete. A means of

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eliminating the cell walls not only would liberate the fat more perfectly, but would leave the remaining cellulose material in far better condition for further working. The residue, a hard fibrous cake in the pressing method, is valuable as a source of by-products, chief among which is cattle food.

To dissolve the cell walls by chemicals is inadvisable, because most substances necessary would affect the quality of the oil. These same walls, eaten away by the action of bacteria, would liberate the oil completely and untouched. "There is a very prevalent hardy and vigorous bacterium that is easy to obtain from brewer's malt," says Mr. Beckman. "This bacterium has been pressed into service in a new oil recovery process.

"The temperature at which these organisms prefer to work is 60 degrees Centigrade, and this fact makes it possible to work under conditions that are self-sterilizing. If a culture of this organism made from brewer's malt is mixed with disintegrated nuts such as copra (dried coconut) together with a weighed amount of ground limestone and sufficient water to form a mush, and the resulting mixture is placed in an incubator at the desired temperature with exclusion of air, active growth takes place, and free oil begins to appear on the surface. After about six days the oil can be recovered from the residue by filtration."

Several advantages are claimed for this method over the older method of pressing. There is more complete extraction of oil, which means greater profit. The quality of the oil is better. The residue, containing as it does bacteria, amino acids made indirectly by the bacteria, and calcium lactate, is more valuable as cattle feed than the cake produced by pressing. It is virtually a predigested food which can be fed in larger quantities than press cake.

The simplicity of the method, the fact that all operations and equipment, except the incubator tanks, are standard, makes the labor required negligible compared with the old method, and the cost of operation is only a fraction of the cost of producing oil by the standard pressing method.

ENGINEERING OPPORTUNITIES IN LATIN AMERICA

OPPORTUNITIES similar to those in the United States before the Civil War are open to engineers to-day in Latin America, R. W. Hebard, New York contractor, states in a report to the American Road Builders' Association. This is the reason, he says, that the Central and South American countries have fascinated the engineer and contractor as perhaps no other in this generation.

"Here in Latin America were found rich productive countries with an interesting historical background, with an educated, cultured governing class, but without railways and highways or ports; important populated cities were lacking in or utterly without adequate water supply or modern sewerage and paving; important picturesque capital cities were found lying back in the mountains, two and three weeks distant from the coast, which could only be reached by mule and small river steamers; countries and cities, in one word, in more or less the same condition as that of the Spanish Colonial period. Such a field was bound to attract the American engineer as no other, not necessarily or primarily for reasons of possible financial gain, but because the pioneer spirit, which is by no means extinct in the American race, asserted itself and drew these men to this part of the world. We have seen, in consequence, commencing one hundred years ago, the American engineer blazing the way well in advance of the banker, salesman and other business missionaries."

Mr. Hebard combats the idea popularly held in this country that all the twenty Latin American Republics are more or less the same. The contractor and his staff working in South America must adapt themselves to widely varying conditions not only of government and political situations but of topography and climate, of transportation facilities or the lack of them, of labor conditions, and of the characteristics of the people themselves.

"In this vast region of which little was known, where almost every facility was lacking, man could dream and see visions of prosperity replacing poverty, of comfort supplanting hardship. A few of these men had vision coupled with common sense and ability. They succeeded. But the majority failed, and they will continue to fail through lack of understanding the economic obstacles which have to be overcome. Propaganda is not now required to convince Latin America that modern highways and railways should be built, that cities should be paved and water and sewage systems installed. All these things are desired in those countries as much as here. The realization of these desires, however, is frequently balked by cold, unescapable, economic facts.

In order to build railways, freight, either actual or potential, must exist. Unfortunately in all tropical countries, agricultural products, which in the temperate zone are the source of the greatest single class of tonnage, are in general of high value and small bulk. This can best be illustrated by comparing wheat with coffee. One family by the use of machinery can readily grow 160 acres of wheat, producing on the average, say 100 tons of grain. One family can grow at the most 6 acres of coffee, with a production of less than 2 tons. Measured in railway tonnage, a given number of people in the temperate zone will produce twenty-five times as much as the same number of people in the tropics. This comparison holds good with coffee, cacao, rubber, etc. While these products have such a high value per pound that they can stand a high freight rate, this rate is often controlled by the competition of primitive transportation methods. It is for these reasons that there are so few railways in the tropics, and the greater part of these have been built with the aid of heavy government subvention.

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tion, was successfully accomplished at Schenectady, N. Y., on March 9, by station WGY, of the General Electric Company. Using a special experimental license, with the call letters W2XAG, the highest power ever used in broadcasting was put on the air at 4:00 A. M. eastern standard time. Tests will be continued for seven days at the same hour, which has been chosen to prevent possible interference with other stations of the country.

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WGY was the first super-power station. In July, 1925, broadcasting began on the then unprecedented power of 50 kilowatts. A number of stations throughout the country are now licensed to use this power regularly. In August, 1927, the General Electric engineers began experimental broadcasting on 100 kilowatts. Early in January this year the power was increased to 150 kw., though no announcement was made of it, and listeners were not informed of the power. The Pacific Coast reported reception of these special broadcasts with unusual strength and clarity, and a listener in Hawaii said that the strength was equal to that of an ordinary Pacific Coast station.

ITEMS

LESLIE C. PELTIER, amateur astronomer of Delphos, Ohio, who discovered the year's first comet a few weeks ago, once again has to share the honors with European astronomers. But the Europeans made the discovery at one of the world's best equipped observatories, that of the University of Berlin and the Prussian Government at Neu-Babelsberg, a suburb of Berlin, while Mr. Peltier has only a small telescope in an observatory largely of his own construction. It was in November, 1925, that his first cometary discovery was made. Before the news had been generally circulated, however, it was also picked up by a Polish astronomer named Wilk, at the University of Cracow. Therefore it was called the Peltier-Wilk comet. Schwassman and Wachmann are the names of the two discoverers of the new comet, and so it will bear the name of Peltier-Schwassmann-Wachmann comet. It is now rapidly receding from the earth, and is visible only in the largest telescopes.

ONE mine rescue station has already been established and two others will be created in the chief mining districts of Ontario following legislative action, D. G. Sinclair, chief inspector of mines for Ontario, told the Canadian Institute of Mining and Metallurgy in annual session at Toronto on March 6. These stations come as the result of governmental investigation of the Hollinger mine fire in 1928, which took 39 lives. Experts now teach miners modern rescue methods in the rescue station already established at Timmins. It also contains apparatus for fighting underground fires, including self-contained oxygen-breathing apparatus, gas masks, an inhalator, oxygen and carbon monoxide detectors, etc.

IN spite of the example in the Cleveland Clinic disaster of the danger of fire and explosion from stored X-ray nitrate base films, many communities are still as liable to such a calamity as they were before, Dr. P. F. Butler, radiologist at the Boston City Hospital, has warned the Congress on Medical Education of the American Medical Association. The safe acetate base film is no more dangerous than so much office stationery, Dr. Butler said. It costs about 20 per cent. more than the nitrate film, but the added expense is good insurance.

TEN automatic weather bureaus, scattered about by airship on the Arctic ice, equipped to broadcast weather conditions three times a day for a year without human attendance, are contemplated by the International Society for Exploration of the Arctic Regions by Means of Aircraft. The plans of the society, generally known as Aeroarctic, are described by Dr. Fridtjof Nansen, its leader. Already an automatic weather observatory has been constructed which tells the temperature, air pressure and humidity by radio for use on a small balloon. In inhabited regions, balloons are often sent up with small recording instruments, and the finder is expected to return it to the proper authorities. As there is no one in the Arctic regions to perform this service, it is necessary to provide the radio transmitter. This operates for about two hours, sending its observations back to the airship base.

CONSTRUCTION material for airplane hangars built recently in inaccessible parts of Persia and New Guinea were freighted over desert and jungle by the planes they now house. A great number of small structural units made of a light alloy were used. Assembling the units is so simple that it was done largely with native labor. Framework of roofs made of these units forms a diamond-shaped checker work. This type of structure, known as the lamella roof, is made of both wood and steel and is found to a large extent in Europe.

THE U. S. Bureau of Standards has found that the quality of parchment and fine papers, which are still made from cotton and linen rags, is injured if the rags contain rayon. This may easily be the case, because the sale of cloth of cotton-rayon mixture is steadily increasing. Hence there is more rayon in rag waste used for paper making.

National Research Council

Committee on the Effects of Radiation Upon Living Organisms

Grants in Support of Research on Effects of Radiation

The second annual meeting of the Committee on the Effects of Radiation upon Living Organisms of the Division of Biology and Agriculture of the National Research Council will be held the latter part of April. At this meeting requests for grants of money and for apparatus to be used during the year beginning July 1, 1930 will receive consideration. Application blanks, which will be mailed on request, should be duly executed and must reach Washington not later than April 10th.

All correspondence should be directed to the Division of Biology and Agriculture, National Research Council, B and 21st Streets, Washington, D. C.

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Science Service, Washington, D. C.

A NEW PLANET BEYOND NEPTUNE

CLOSE to the place in the sky where the late Percival Lowell predicted that there was a new and undiscovered planet, his successors at the Lowell Observatory have discovered the new member of the solar system. It is far beyond the orbit of Neptune, hitherto supposed to be the most distant planet. Lowell, who died in 1916, made his prediction on the basis of the way Uranus was being pulled out of its proper path by the gravitational attraction of a then unknown body.

The discovery was made with the new Lawrence Lowell telescope, completed about a year ago. The lens is a photographic one, thirteen inches in diameter and 63 inches in focal length. It was made by Carl Lundin, of the Alvan Clark Co., in Cambridge, Mass., makers of the lenses of many of the largest telescopes. Because it includes a very wide angle in the sky, this telescope, really a huge camera, is especially adapted to the search for a planet, and the Lowell astronomers have been working on the problem for nearly a year. They have had the new planet under observation since January 28, but it was necessary to watch it for many weeks to make sure that it was really a planet.

This is the first planet discovered since 1846. It was then that Johann Gottfried Galle, at the observatory at Berlin, discovered Neptune, using a prediction furnished by a young French astronomer, Urbain J. J. Leverrier.

At present the planet is in the constellation of Gemini, the twins, high in the western evening sky. Only a large telescope will reveal it, however, as it is of the fifteenth magnitude. Even on a clear, dark night, the unaided eye can not see objects fainter than about the sixth magnitude.

Further observations will be needed before astronomers learn as much about it as they know about the inner planets. According to Lowell's prediction it should be about one and one half times as far from the sun as Neptune, or about 4,000,000,000 miles, compared with the earth's distance of 92,900,000 miles. In size, it is undoubtedly larger than the earth's 7,918 miles diameter, and probably smaller than 32,932 miles, the diameter of Neptune. Its mass is probably less than half that of Neptune, which is about 17 times as massive as the earth. According to Kepler's law of the relation between planetary distances and periods, if it is one and one half times as far from the sun as Neptune, it would make one revolution in its orbit around the sun in 282 years, instead of 164 years, the period of Neptune. Being so far from the sun, the planet is probably very cold. No name has yet been assigned to it, but the discoverers have the privilege of giving it one.

PERCIVAL LOWELL'S PREDICTION OF 1915

LOWELL published his "Memoir on the Trans-Neptunian Planet" in 1915, as Volume 1, Number 1, of the Lowell Observatory *Memoirs*. In making his prediction, Lowell used the general methods that led in 1846 to the discovery of the planet Neptune, until this year the outpost of the solar system. Lowell began his memoir:

"Ever since celestial mechanics in the skillful hands of Leverrier and Adams led to the world-amazed discovery of Neptune a belief has existed begotten of that success that still other planets lay beyond, only waiting to be found. Leverrier himself, with the far-sight of genius, was firmly of this view, though unfortunately over-sanguine of the happy date of its demonstration. In consequence since his time many attempts have been made to indicate the position of one or more of these unknowns, attempts for the most part of no scientific value because not founded on rigorous mathematical investigation. For so complicated is the problem that all elementary means of dealing with it lead only to error. The sole road to any hope of capture lies through the methodical approach of laborious analysis."

But Lowell's task was more difficult than that of his predecessors. As he said in his prediction: "We can not use Neptune as a finger-post to a trans-Neptunian as Uranus was used for Neptune because we do not possess observations of Neptune far enough back. A disturbed body must have pursued a fairly long path before the effects of perturbation detach themselves from what may be well represented by altering the elements of the disturbed. Neptune has not been known long enough to do this."

As the great astronomer spent hours in computations and study, he realized the complexity of his self-appointed task and envied the earlier mathematicians who dealt with less distant planets:

"That Leverrier's solution gave him limits which were erroneous shows how necessary to a full comprehension of the problem is the rigorous and more complete method of solution. This does not detract from the great analytical skill displayed by both Adams and Leverrier in their masterly attack on the problem. That alone deserved success. Why it attained it is nevertheless a cause for some surprise, for Leverrier left out terms bigger than two he retained. The explanation would seem to lie in the nearness of Neptune and the near circularity of its orbit. Neptune turns out to have been most complaisant and to have assisted materially to its own detection."

In his summary, Lowell gave the following scientific data which the astronomers used as a basis of their sky-searching that finally resulted in the confirmation of his discovery: "Mean longitude of epoch around 0 degrees: epoch 22.1 degrees; semi-axis 43.0; mass 1.00; excentricity .202; place of perihelion 203.8 degrees heliocentric longitude July 0, 1914—84.0 degrees; mean longitude of epoch around 180 degrees: epoch 205.0 degrees; semi-axis 44.7; mass 1.14; excentricity .195; place of perihelion 19.6 degrees; heliocentric longitude July 0, 1914—262.8 degrees; the unit of mass being 1/50,000 the mass

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of the Sun. It indicates for the unknown a mass between Neptune's and the Earth's; a visibility of the 12–13 magnitude according to albedo; and a disk of more than 1 second in diameter. From the analogy of the other members of the solar family, in which excentricity and inclination are usually correlated, the inclination of its orbit to the plane of the ecliptic should be about 10 degrees. This renders it more difficult to find.''

THE DISCOVERY OF NEW PLANETS

For the third time in the history of the world, the research of astronomers has revealed a new member of the solar system—the family of bodies, large and small, that revolve around the parent sun from which they were born many ages ago. To Percival Lowell, born in Boston on March 13, 1855, belongs the credit, though he died on November 12, 1916, and now rests in a stone mausoleum at the observatory he founded, close to the dome of the great telescope with which he did his work. It is at this observatory, at Flagstaff, Arizona, that his successors, under the leadership of V. M. Slipher, have located the new planet, close to the place in the heavens where the founder's researches predicted that it would be.

Curiously enough, Lowell was born on the seventy-fourth anniversary of the first modern planetary discovery—that of Uranus by Sir William Herschel on March 13, 1781. With a peculiar sense of the fitness of things, Dr. Slipher chose March 13, 1930, the eighty-fifth anniversary of Lowell's birth and the one hundred and fifty-ninth anniversary of the discovery of Uranus, to announce to the world that Lowell's predictions had been correct.

September 23, 1846, brought the eighth major member of the solar system to the attention of astronomers, and from that time to now no additions have been made. But this is probably not the last. It was the failure of Uranus to move exactly as expected that led astronomers to explain the discrepancies as due to the gravitational attraction of an unknown planet beyond. From these studies the position of Neptune was predicted and the planet was found. As many more years of observations of Uranus became available, still other discrepancies appeared, discrepancies which Lowell studied and used, as we now know, to such good advantage. As Uranus, Neptune and the new planet itself are studied in more detail, and have moved farther in their slow plodding course, other discrepancies, which are now vaguely glimpsed, will appear and still other planets—the ninth, the tenth and perhaps even the eleventh and twelfth, will be discovered. But each will be more difficult than the last, and it may be that the most distant planets will forever continue to move around the sun, unsuspected by man.

Sir William Herschel was a musician at Bath, in England, when he became interested in astronomy. He made a number of telescopes, all reflectors, with dish-shaped mirrors to bring the rays of light to a focus. Finally, on the night of March 13, 1781, he came home from a concert and, according to his habit, went out to the back of his house where he and his sister Caroline swept the skies. Then he was using a little telescope with a mirror only seven inches in diameter. Sweeping through the constellation of the twins, now high in the western sky, and the same group in which the Lowell planet has appeared, he saw something strange. Instead of a tiny point of light, like the thousands of stars that flashed across his view, this was a disk of light. Always modest, he did not suppose that he had found a new planet, the first such discovery ever recorded, but suggested that it might be a comet. But as the object was watched and watched, its character as a planet was established. This brought fame to Herschel as an astronomer; King George III, then on the throne, gave him a pension, and requested that he move to Slough, near Windsor Castle. Herschel gave up his music, devoting his life to a study of the stars and becoming one of the greatest astronomers of all times. The discovery of Uranus made this possible.

Incidentally, the name that Herschel proposed for the planet was not Uranus, but ''Georgium Sidus,'' in honor of the king. English astronomers later suggested that it be called Herschel, and this name was actually used for a time in England. Finally, however, the suggestion of the German astronomer, Johann Elert Bode, prevailed, and it was named Uranus, thus according with the mythological names given the inner planets.

Great as was Herschel's discovery, Uranus was literally waiting to be picked up by some keen eye. Bright enough to be just visible to the naked eye under good conditions when one knows just where to look, it could not have long avoided discovery as telescopes became more numerous. But the next discovery was of a different kind, for before it was seen in the sky, it was detected in a mass of figures in a long and involved calculation.

Uranus had only been observed a few years when it was found that it did not move as it should, according to Newton's laws. The pull of Saturn and Jupiter, its nearest and largest brother planets, was allowed for, but even so there was a discrepancy. By 1845 this was about two minutes of arc—about a fifteenth of the moon's diameter. This was the difference between where Uranus should be and where it was actually observed. A number of suggestions were made, one—a rather obvious one—being that it was due to the gravitational pull of a farther and unknown planet. But that any one could calculate from the discrepancy the location of the unknown planet seemed to many to be a hopeless task.

A 35-year-old French astronomer, Urbain Jean Joseph Leverrier, decided that he could do it. In September, 1846, he completed his laborious computations and wrote to Johann Gottfried Galle, then an assistant at the observatory at Berlin, the following:

''Direct your telescope to a point on the ecliptic in the constellation of Aquarius, in longitude 326°, and you will find within a degree of that place a new planet, looking like a star of about the ninth magnitude, and having a perceptible disk.''

On the night of September 23, Galle turned his telescope to this point. He had an accurate map of the

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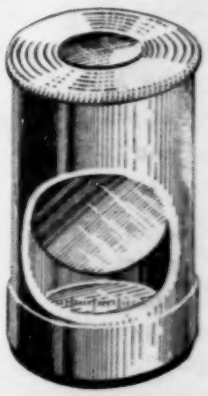

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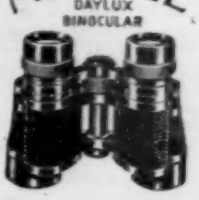

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stars in this region, so all he had to do was to check each on the map against those in the sky. The extra one in the heavens then must be the planet. Within half an hour after he started looking, he found the stranger within 52 minutes, less than a degree, from the place that Leverrier had indicated. The telescope that he used is to-day preserved in the great German Museum at Munich. Galle lived to the age of ninety-eight years and died as recently as 1910.

Though Leverrier and Galle were the first to make the planet known to the world, an Englishman, John Couch Adams, deserves just as much credit as the Frenchman. In the autumn of 1845, this young student at Cambridge, then twenty-six, completed his calculations, with no suspicion of Leverrier's similar efforts across the Channel. He called at the Greenwich Observatory, in London, to present his results to the Astronomer-Royal, Sir George Airy. But that gentleman was at dinner when he called; the butler declined to disturb him. Adams left his paper, which Sir George acknowledged, but then pigeonholed.

By July, 1846, however, after Leverrier had published two preliminary papers on the subject, Sir George became interested, and asked Professor Challis, at Cambridge, to look for the planet. Challis, however, had no maps of the region and so he had to measure the position of a number of stars, night after night, to determine which was moving, for the planets move among the stars. But he had started too late, and while he was still searching, Galle won the race, and Adams, through no fault of his own, lost the honors that might have been his. Then it turned out that Challis had actually measured the new planet twice, the first time early in August, but had not analyzed his observations to determine which object was the planet. Further checking of older records showed that another French astronomer, Lalande, had actually noted it fifty years earlier, without knowing what it was.

The planet was named Neptune by the French, with a touch of sarcasm, it has been said, because England ruled the seas, and they were jealous of the apparent attempt of England to take their honors away from them by pushing the claims of Adams.

Neptune revolves once in its orbit around the sun in 165 years, so that since its discovery it has made just half a revolution. Uranus, however, with a year equal to eighty-four of ours, has made about two revolutions. If there were to be any gravitational pull by still another planet, the more rapidly moving planet would show it best. Sure enough, a slight discrepancy was noticed in the motion of Uranus that could not be explained by the attraction of any known body. It is only about five seconds, a twenty-fourth as large as it showed in 1845. Lowell took advantage of this discrepancy but his was a task more difficult than that of Leverrier or Adams.

The observations were not so easy, either. Lowell died in 1916. Finally, last year, after various delays, the Lowell Observatory obtained a new telescope, given by his brother, Dr. A. Lawrence Lowell, president of Harvard University. This has a photographic lens 13 inches in diameter, with a focal length of 63 inches, so that it is really a huge camera. Covering a wide area of the sky, it is especially adapted to the search for a planet, and after a year of study of photographs made with it, the planet was found. C. W. Tombaugh was the astronomer who first actually observed it, but to the entire Lowell Observatory staff, including its director, Dr. V. M. Slipher, his brother, E. C. Slipher, Dr. C. O. Lampland, K. P. Williams, T. B. Gill, G. H. Edwards and Dr. J. S. Duncan, professor of astronomy at Wellesley College, now visiting at Flagstaff, belongs the credit for the third planetary discovery.

ITEMS

THE first discovery of activity by the Mediterranean fruit fly in Florida for the current year was made near Orlando, where the original infestation occurred, by agents of the U. S. Department of Agriculture. It is a very small infestation, being confined to two lone pieces of fruit from a sour orange tree, which is grown extensively for ornament and as a grafting stock for sweet oranges. It is enough, however, to indicate that last year's clean-up was not the final blow in the campaign and that there is still work for the eradication forces to do. Quarantine workers recently repelled an invasion of the fruit fly at the gates of California, though the insect did not come from Florida. Larvae were found in oranges on board a ship from Hawaii, where the fly has been firmly established for a number of years.

AN all talking picture in which the entire cast will consist of various animals and reptiles, and featuring the rattlesnake, is being planned for an early filming, according to an announcement made in an address at the Carnegie Museum, Pittsburgh, by Dr. Raymond L. Ditmars, curator of reptiles at the New York Zoological Gardens. Dr. Ditmars stated that the rattlesnake has the best "speaking" voice of all the animals and reptiles tested for the talking screen, and that the well-known warning sound of the rattlesnake has been broadcasted over the radio, being reported as clearly heard far at sea and recognized by thousands in America. The lion was said to have the poorest voice for "talkie" purposes of all the creatures tried before the microphone.

WHEN the storks of the village of Grünewalde fly north from Africa this spring they will find their old home on the schoolhouse, but they will hardly know the place. For the schoolhouse had to be reconditioned during the winter, and the nest had to be taken down. This incidentally gave naturalists a chance to examine a stork's nest of championship proportions, before putting it back on the roof. The nest was over six feet in diameter and not much less than three feet high, larger by half than an ordinary stork's nest. It could contain four men sitting on chairs around a table. Sticks as thick as an arm had been built into its walls, and the interstices filled with moss, straw, hay and reeds. In odds and ends of space not needed by the storks, upwards of 50 sparrow families lived.

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SCIENCE NEWS

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QUARANTINE STATION FOR WORK ON PARROT FEVER

WHEN the U. S. Public Health Service's studies on parrot fever are resumed, it will be on one of the government's quarantine stations, probably either the one on Craney Island, near Norfolk, the one on Reedy Island in the Delaware River, near Lewes, or the one on Swinburne Island, New York City. A fourth location, an island quarantine station at Portland, Maine, is also under consideration, but is not favored so much as the other three, because of the severe winters there.

The selection of an island quarantine station has resulted from recommendations of the special board appointed by Surgeon-General Hugh S. Cumming to investigate the parrot fever situation at the Hygienic Laboratory, where eleven persons contracted the disease while the studies were going on.

The board reported that the present facilities at the Hygienic Laboratory are totally inadequate, and recommended that a new building be constructed. Pending this construction, thorough overhauling of the present structure, including painting, cleaning, etc., was advised.

The board further recommended that further investigations on parrot fever or similar diseases be temporarily carried out at an isolated place. The maritime quarantine stations, particularly those situated on islands, were immediately considered.

These have laboratory and hospital accommodations for handling cases of infectious disease coming in on ships. These facilities can readily be enlarged to take in the parrot fever investigations. The station at Reedy Island has the most convenient arrangements for quartering the investigators and their families, and the climate is not too severe. It is isolated, but not inaccessible at all. However, no decision has yet been made as to which station will be chosen for this work.

Neither have the men to carry it on been selected, although Dr. Charles Armstrong, who was conducting the parrot fever studies before he became ill, and Dr. L. F. Badger, who has collected blood from recovered parrot fever patients for convalescent serum, have been mentioned.

Dr. Armstrong is entirely well but still rather weak, as he has given blood several times for the serum with which other parrot fever patients are treated. It is expected that the parrot fever studies will be resumed within a week or so, as soon as the new location can be made ready.

No new cases have been reported in the last three days, and all the patients are doing well except the two Negroes, Fred Blackwell and C. Murphy, who are still quite sick.

Of the entire force of the Hygienic Laboratory, numbering about 120, ten have contracted the disease, and one died of it. In only two cases were the victims working directly on the disease.

PHYSIOLOGICAL EFFECTS OF ELECTRIC SHOCK

ALTERNATING current is more dangerous at low voltages than at high voltages and direct current is more dangerous at high than at low voltages. This is the curious conclusion reached by Professor W. B. Kouwenhoven, an electrical engineer, and Professor Orthello R. Langworthy, associate in neurology, following extensive studies on rats in the laboratories of the Johns Hopkins University.

The results of tests on 286 rats can not be applied directly to men or other animals. But the facts learned tie in well with existing knowledge of the effect of electricity on human beings. Statistics show that the annual death rate from electric shock is nine tenths per 100,000 and that one third of these fatal accidents occur on low voltage circuits.

"On high voltage circuits the victim is often thrown away from the conductors by the severe contraction of the muscles, but on low voltage circuits it is often impossible to let go," according to a recent report to the American Institute of Electrical Engineers. "No authentic record has been found, however, of a death on a 110-volt direct current circuit. If the skin is wet, 110-volt alternating-current house circuits are dangerous. The sensation produced by an alternating current of 15 to 20 thousandths of an ampere is extremely painful and a current of 100 milliamperes may cause death."

The tests on the rats were conducted at 110, the ordinary house potential, 220, 500 and 1,000 volts with both alternating and direct current. The animals did not die of heart failure but of respiratory failure.

In many cases the heart continued to beat long after the animal ceased breathing. In an effort to find these "changes in the nervous system incompatible with life," autopsies were performed on all specimens. They reveal that the death of rats which lived only a few hours after shock was caused by hemorrhages in the brain.

Contrary to popular belief, injuries were not directly proportional to the amount of current passed through the body. "Not only is the initial voltage of importance, but the duration of contact and the size of the animal."

The general effect of the alternating current shock was much more severe than that of direct current. Muscular contraction was more intense, more animals were paralyzed and gross injuries to the central nervous system occurred oftener. Among the animals shocked by direct current only one suffered hemorrhage in the cord and only one bled from the nose, while many alternating current victims were so affected.

The duration of shock was varied from five to sixty seconds at the lower voltages and from an instant to four seconds at higher potentials. If the animal was unconscious at the end of the shock, an attempt was made to revive it with a method as similar as possible to the Schaefer method of prone pressure resuscitation,

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practiced widely for man. If this failed, the autopsy was performed immediately. Otherwise the animal was allowed to live normally a few days.

PARALYSIS FROM JAMAICA GINGER MIXTURE

INVESTIGATION into the nature of the poisonous substance in Jamaica ginger which caused paralysis outbreaks in Tennessee, Oklahoma, Kentucky and other states has been hampered by the absence of samples of the beverage that was actually drunk by any of the patients.

The drink was sold in small bottles containing from 60 to 80 per cent. alcohol. The rest was Jamaica ginger. Prohibition officials allowed this to be manufactured and sold thinking that the large amount of ginger would make it impossible for any one to use it as a beverage. However, several hundred hardy drinkers consumed it in large amounts. Some of the patients admitted having drunk as many as fourteen or fifteen bottles of the stuff in a day or two. Because of the small amount in each bottle, each was well drained, and official investigators have not been able to obtain any of the same beverage that was drunk. Their analyses have been made on samples furnished by the manufacturer, which are supposed to be from the same lot as that causing the paralysis.

In these samples, no metal, no alkaloid, no isopropyl-alcohol, no denaturant of any sort has been detected. The supposition is that either the samples examined were from a different lot than those drunk by the paralytics or the stuff was adulterated by a bootlegger. In Kentucky, near Berea and Richmond, the stuff was sold by a man in a car who collected cash payments for every bottle sold. This strengthens the bootlegger theory.

The fact that many of the paralytics are people of some prominence in their own communities has also hampered the official investigations. There is a natural reluctance to admit the drinking, and officials feel that probably some details are being withheld. While 119 cases have been investigated in Tennessee, official estimates place the number affected in that state at 400 or 500. In Kentucky, only 6 or 8 have been reported. These were mostly painters.

The paralysis set in as long as a week or even three or four weeks after the suspected beverage had been consumed. Some patients also complained of stomach and intestinal upsets. The paralysis affects the legs chiefly so that walking is extremely difficult or even impossible. However, there is sensation, and a pin prick or touch of a hand on the paralyzed leg is felt. Some patients have had paralysis of the fingers, enough to give difficulty in buttoning their shirts or handling small objects.

ZINC TREATMENT TO KILL WEED SEEDS

A METHOD of chemical weeding for seedling beds of evergreen trees has been worked out at the Northern Rocky Mountain Forest Experiment Station at Missoula, Montana. According to W. G. Wahlenberg, formerly of the U. S. Forest Service, who describes the work in detail in a new technical publication of the U. S. Department of Agriculture, this method saves 27 per cent. of the cost of producing two-year-old tree seedlings, besides saving many young trees that would be destroyed or damaged by the old laborious process of hand weeding.

The new method, as worked out during several years past at the Savenac nursery, consists in applying one and one eighth ounces of zinc sulfate dissolved in one quart of water to every four square feet of seed-bed soil. This attacked and poisoned the roots of the weeds as they tried to leave the germinating seeds. The roots of the sprouting evergreens were more resistant and were not injured. The situation was roughly analogous to that in the blood of a malaria patient who takes quinine. The drug kills the germs, but does not harm the body tissues.

During the experiments other chemicals were tried, but zinc sulfate proved to be the most effective. Higher and lower concentrations of the zinc sulfate were also tried, but the higher concentrations sometimes injured the tree seedlings, and the lower ones were not so effective against the weeds. The concentration to be used for best effect must depend partly on the nature of the soil. A finer-grained soil than the one at Savenac would require more of the sulfate, a coarser-grained soil less.

The method is not without its disadvantages, which must be guarded against. The sulfate tends to make the soil acid, and liming will need to be carried on in some localities to correct this. If the soil is stirred after applying the sulfate to the surface the effect is lost; weeds sprout readily in spaded or plowed places after treatment. Fresh treatment of a seed bed is therefore necessary every time a new lot of tree seeds is planted.

One incidental advantage seems to come from the treatment. After the seedlings are taken up and the soil re-plowed, field peas are frequently planted as a green manure crop. The residual zinc in the soil does not injure the peas but rather increases their growth, apparently through encouraging the colonies of nitrogen-fixing bacteria on their roots.

THE EUROPA AND THE BREMEN

THE arrival in America of the *Europa*, sister ship of the *Bremen* and second new speed queen of the oceans, focuses attention upon the great engineering and economic difficulties which for twenty-two years gave the speed honors of the seas to the British S. S. *Mauretania* and which are partially overcome by these German trans-Atlantic liners.

Application of the latest developments in power plant and ship design should enable the *Europa* and the *Bremen* to compete successfully with their rivals for the de luxe trans-Atlantic business which costs much per passage, but pays the steamship companies poorly. The success of faster ships yet to be built will depend largely on the advance of engineering and ship design and the amount of subsidy given their owners.

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OSTERHOUT, W. J. V., and HILL, S. E. Negative variations in *Nitella* produced by chloroform and by potassium chloride.

ANSON, M. L., and MIRSKY, A. E. Protein coagulation and its reversal. The preparation of insoluble globin, soluble globin and heme.

MIRSKY, A. E., and ANSON, M. L. Protein coagulation and its reversal. Improved methods for the reversal of the coagulation of hemoglobin.

BARRON, E. S. GUZMAN, and HOFFMAN, L. A. The catalytic effect of dyes on the oxygen consumption of living cells.

BLINKS, L. R. The direct current resistance of *Nitella.*

THE JOURNAL OF GENERAL PHYSIOLOGY, founded in 1918 by Dr. Jacques Loeb, contains practically all the investigations of Dr. Loeb after that time.

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The *Europa* and the *Bremen* are streamlined both above and below water. Principles of airplane design have been applied to water craft. Both have a huge bulging nose, "bulbous bow," beneath the water and their rudders have been modeled very closely after airplanes. Oval funnels, well-rounded bridge and superstructure and sharply pointed bows are characteristic.

Light, welded rolled steel has largely replaced the heavy cast iron of older ships. The turbines are stronger and smaller and use more steam at higher pressures and temperatures to develop more power than their contemporaries. The efficiency of their oil-burning boilers far surpasses that of any other liners.

Even with these advanced engineering achievements, the *Bremen* burns approximately $6,000 worth of fuel-oil a day when oil costs $1.80 cents a barrel. But she uses only about 0.69 pound of oil per shaft-horsepower to the *Leviathan's* pound.

Possibly because they are the newest and grandest of the ocean-going palaces they can command a fair share of the select patronage. But they will have stiff competition and will make many trips with few passengers. One palatial liner with a capacity of more than 2,500 passengers averages during a year only about 1,250 on east-bound voyages. Very nearly the same is true of all the big vessels—the *Majestic, Berengaria, Leviathan, Aquitania* and *Mauretania.*

They largely pay for themselves by the publicity they bring their owners and nations, and this is expensive publicity. It has been carefully estimated that in the United States the *Europa* and the *Bremen* would have cost considerably more than $25,000,000 each. To build a ship that will add just three knots to their records would cost millions more. This ship would consume approximately twice as much fuel as the *Europa* or the *Bremen.*

To increase speed just 10 per cent., power must be increased 30, 40 and even 50 per cent., depending on hull design. This is well shown by tests on the airplane carrier *Saratoga,* one of the fastest ships afloat, which was built as a necessity with little consideration of cost. To make 22.57 knots the *Saratoga* requires 44,709 horsepower; to make 28.34 knots she needs 86,000 horsepower; 30.51 knots, 107,793 horsepower and 33 knots 155,843 horsepower. At 34.9 knots she is consuming approximately 213,000 horsepower, more than that developed in any hydro-electric or steam power plant in the world.

ITEMS

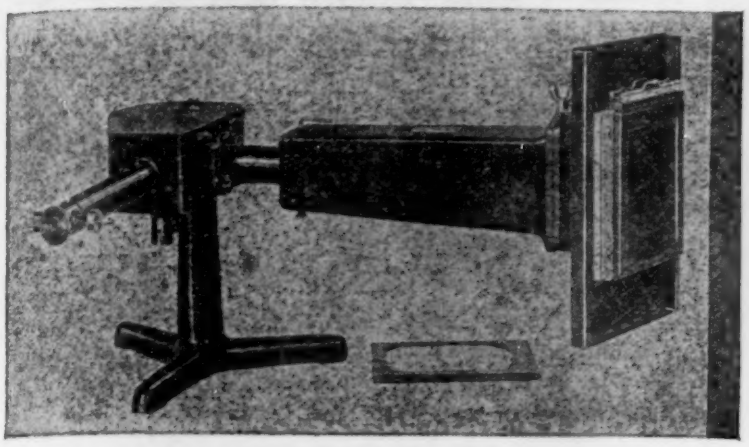
STARS larger than any now known may soon be found by astronomers at the Mount Wilson Observatory, using a new instrument that has just been put into use. It is known as the fifty-foot interferometer, and consists of a steel "bridge" 54½ feet long on which move mirrors to pick up the light of a star. With a smaller instrument of the same type, attached to the 100-inch telescope, the world's largest, F. G. Pease found the largest star known at present. This is Antares, in the constellation of the scorpion, and is large enough that if it were hollow it would hold the solar system with the earth and other planets out to Mars, with 55,000,000 miles to spare on all sides.

DETAILS of a new method for measuring the heart's output of blood were described by Dr. Arthur Grollman, of the Johns Hopkins University, at the Chicago meeting of the American Physiological Society. Four quarts of blood a minute is about what the heart pumps in normal persons. Of course the amount can not be measured directly, and various indirect methods are resorted to by physiologists. Dr. Grollman used acetylene gas. Making use of the fact that all the blood pumped by the heart goes through the lungs, he determined with a special apparatus the amount of acetylene gas the lungs took up in a given time. From this he was able to calculate the amount of blood going through the lungs in that time, and from this the amount of blood—about 4 quarts—put out by the heart every minute.

A SMALL herd of wild horses, the last reminders of the days many centuries ago when western Germany was a "Wild West," are now carefully watched and tended on a ducal estate in Westphalia. They range in the Merfeld fens, near Dülmen, which are the property of the Duke of Croy. The animals are kept in a large fenced area and left practically to themselves, unshod and without stables or any kind of shelter. They are rather small, tending to the pony type. There are still some 130 head of them; the surplus, about 20 young stallions yearly, are sold.

THE health of a Diesel engine is now determined by taking its temperature. A thermometer in the exhaust of these oil-burning, internal combustion engines, which are increasing rapidly in popularity, can be relied upon to show how combustion is proceeding in the cylinders, says a recent issue of *Power.* Curves have been drawn to give operators the correct value of temperature for different loads. For example, the exhaust temperature of the four-stroke cycle, air-injection Diesel is directly proportional to the load, the points for the curve forming a straight line. Its full load temperature is 700 degrees Fahrenheit. Apparently most types of Diesels have a no-load exhaust temperature of about 230 degrees.

ICE on airplane wings, the cause of many accidents in the past, may lose much of its terror with the aid of a new warning device developed by the Bureau of Standards. It does not prevent the formation of ice, but gives the pilot warning, by the shining of a red light on his instrument board, when conditions are such that ice is likely to form. Then he can take proper precautions, either landing or going into a warmer layer of air. Experiments have shown that ice forms at temperatures between 26 and 32 degrees Fahrenheit, when the airplane is flying in air that is saturated with water vapor. The instrument consists of a temperature-actuated switch, operating on a battery of pocket flashlight cells. When the dangerous temperatures are reached, the red light flashes. If it is cold and dry, the pilot can either ignore its warning or switch it off, for then there is no danger, even at the low temperatures.



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Science Service, Washington, D. C.

THE COMING TOTAL ECLIPSE OF THE SUN

THE first total eclipse of the sun in the United States since 1925 is the attraction that will bring astronomers from all over the country to positions near San Francisco on April 28. Then the tip of the moon's shadow will graze the earth along a line crossing the coast in Marin County, California, about 20 miles north of the Golden Gate, traveling northeastwards across the state, passing just south of Marysville and Honey Lake.

Crossing into Nevada about 40 miles north of Reno, the shadow continues over the southeastern corner of Oregon, over Idaho, and then leaves the earth at a point some fifty miles east of Butte, Montana. Only over this narrow line, scarce a half mile wide, will the sun be obscured, and the ordinarily invisible corona around it flash into view for a second or so.

This is a very unusual eclipse, a so-called "central" eclipse, the first of its kind in 18 years. Usually, an eclipse is either total or annular. Either is caused by the moon getting directly between the sun and earth. But the distances vary. Sometimes the shadow of the moon reaches to the earth and beyond, and the regions which it crosses see the sun totally obscured. This is a total eclipse. At other times, the shadow, conical in shape, with the point away from the sun, fails to reach the earth. Then the eclipse is "annular"; the moon, seeming a little smaller, does not fully cover the sun, and a ring of sunlight is seen around it.

A central eclipse, like the coming one, is both. Where it starts, out in the Pacific Ocean, it is annular. The earth, being round, bulges several thousand miles towards the moon, so by the time the eclipse approaches the Pacific Coast the tip of the shadow reaches the earth and the eclipse becomes total. But instead of the shadow on the earth being a hundred miles or more in diameter and causing an eclipse lasting several minutes, the shadow in April will be under a mile, and the eclipse at its longest will last a second and a half. Then, after the tip leaves earth in Montana, the path in which the ring of sun can be seen continues across Saskatchewan, Manitoba, Hudson Bay, Quebec and Labrador and ends out in the middle of the Atlantic Ocean, 5 hours, 29 minutes and 55 seconds after it began, some ten thousand miles away.

An annular eclipse is of no scientific value, but along the path of totality astronomers will try to make observations only possible at a total eclipse. At Camptonville, Yuba County, about 125 miles northeast of San Francisco, will be a party from the Lick Observatory of the University of California, under the direction of Dr. J. H. Moore. Dr. D. H. Menzel will be with him. Farther east, near Honey Lake, will be a group from the Mount Wilson Observatory, in charge of Dr. S. B. Nicholson. On the edge of the Black Rock Desert, about 12 miles northwest of Gerlach, Nevada, Dr. Heber D. Curtis, director of the Allegheny Observatory at Pittsburgh, will make observations.

Flying in airplanes above will be still other astronomers. Dr. R. J. Trumpler, of the Lick Observatory, will fly in an army airplane, while other observations will be made from planes from the Mare Island navy yard.

Because of the great number of bodies in the solar system that exert a pull of gravity on the moon, its path is a very tortuous one, and astronomers are not able to predict its path with absolute precision. As a result, says Dr. R. G. Aitken, associate director of the Lick Observatory, in a report to the Astronomical Society of the Pacific, "it is still impossible to predict with perfect accuracy the central line of the shadow path at any eclipse. The outstanding error is only a small fraction of a mile, and when the eclipse lasts one or more minutes this is quite unimportant, since the eclipse path is then many miles wide. On April 28, 1930, however, this small uncertainty is serious, and, for all his care, the astronomer may find himself just too far north or too far south to be on the shadow path.

"That is the reason why astronomers at the coming eclipse are planning chiefly to make spectrographic observations of the sun's lower atmospheric layers, known as the chromosphere; for these can be carried out successfully and with results of decided value, even if the spectrograph is just outside the shadow path.

"A photograph of the corona, however, can be taken only at stations on the path. The Lick Observatory-Crocker Expedition, therefore, plans to set up three cameras, one on the computed central line, one about one third of a mile north of it, and a third an equal distance to the south."

In order to predict the most accurate position possible of the path of the shadow, astronomers at the U. S. Nautical Almanac Office, in Washington, under the direction of Professor James Robertson, have made a last-minute calculation of the path. Using observations of the moon made as recently as March 12, they have calculated the path to within a hundredth of a minute of latitude and longitude, or less than a hundred feet. With such recent observations, there should be little wandering of the moon between the last one and the eclipse itself.

HEMIANTHROPUS OSBORNI

FRAGMENTS of skull, face-bones, jaw and shoulder-blade, found by Professor Wilhelm Freudenberg in Ice-Age gravels of the Bammental near Heidelberg, have proved upon piecing together to be the remains of a big ape-like creature with a brain bigger than that of any known anthropoid ape, either living or extinct, says *Natural History*, a publication of the American Museum of Natural History, New York. The animal has been named by its discoverer *Hemianthropus osborni*, in honor of the seventieth birthday of Dr. Henry Fairfield Osborn, president of the American Museum.

The *Hemianthropus* part of the name is Greek for "half-man." The creature, if an ape, was a highly ad-

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vanced kind of an ape. Its somewhat gorilline face was uncommonly wide, and its brain is stated to surpass that of the Trinil skull from Java, and to equal in size the brain of Neanderthal man. The Trinil skull, *Pithecanthropus,* is considered to be human by a great many scientists, though some are of the opinion that it belonged to an ape; but Neanderthal man is unquestionably human. The editor of *Natural History* adds a note that "the question of the validity of *Hemianthropus osborni* as distinct from Heidelberg man remains an open question."

The Heidelberg man has been represented to date only by a jawbone found at Mauer near Heidelberg, in sands of the same geologic age as the gravels that have yielded the bones of *Hemianthropus.* It has been regarded as undoubtedly human, though of a very primitive type, characterized chiefly by its exceedingly massive structure and its almost total lack of a chin. The jaw which Professor Freudenberg found is even more chinless than the classic Mauer specimen. Its lower border resembles that of the Java skull.

Professor Freudenberg has been a tireless searcher for human and anthropoid remains in the region around Heidelberg. Recently he found a portion of a broken and water-worn arm-bone which he attributes to a fossil gibbon.

MID-ATLANTIC ISLETS AND GEOLOGICAL THEORIES

FOUR tiny islets in the middle of the Atlantic Ocean, the largest of them only an eighth of a mile across, bear heavy evidence against the validity of the Wegener hypothesis of the westward drift of the American continents, which has proved very attractive to many geologists. Dr. Henry S. Washington, of the Carnegie Institution, discusses the significance of these rocks, and especially their bearing on the problem of the origin of the long submarine ridge of which they are a part, in the first issue of the *Journal* of the Maryland Academy of Sciences.

The islets are known as St. Paul's Rocks, and they stand up alone in the midst of the South Atlantic, almost midway on the shortest line that can be drawn between Africa and South America. But although the highest point on them is only 64 feet above high-tide mark, the islands are lofty mountain-tops. For they are a part of a 9,000-mile-long submarine mountain range, or ridge on the ocean bottom, that extends through the middle of the Atlantic Ocean throughout almost its entire length, and rises in places as much as 18,000 or 20,000 feet above the bottoms of adjacent deeps. Other peaks that raise their heads above the surface of the sea form the islands and island groups of the Azores, Ascension, Tristan da Cunha, St. Helena, Gough and Bouvet. Of these, all except St. Helena lie directly on top of the ridge.

The course of the ridge is most peculiar and suggestive. It holds very closely to mid-Atlantic throughout, running almost directly north and south in the South Atlantic, swinging northwesterly to parallel the coasts of South America and western Africa, then north and northeasterly in the North Atlantic. In general, it runs parallel with the continental land lines through its whole length.

Geologists have long puzzled over why this ridge should exist and why it should follow the course it does. Two completely opposite theories have been advanced: one, that it represents the edge of a rift in the earth's crust caused by the pulling apart of the eastern and western continents; the other, that it is due to the squeezing together of the crust under the ocean basin, causing it to hump up.

The rocks of the little mid-oceanic islets furnish the clue. All the other islands located on the ridge are volcanic, and their lavas tell little, because they are melted rock, coming from unknown depths and resulting from imperfectly known physical and chemical processes. But the stone that forms St. Paul's Rocks is not a lava, but part of the deep crust of the earth, like the granite of our older mountains on land, though even more massive and heavy, and different in its chemical composition. The group of St. Paul's Rocks is the only place on the whole course of the ridge where the real crustal stuff from under the ocean bottom comes to the surface.

Dr. Washington finds that this massive rock shows signs of having been subjected to tremendous squeezing pressures, such as could have come only from sidewise thrusts humping up the ridge between them, and not from a tensional effect resulting from the pulling apart of the continents.

A NEW PHOTOELECTRIC CELL

RUNNING motors with electricity from sunlight is one of the possibilities forecast by the invention of a new type of cell that converts light directly into useful quantities of current. It is the invention of Dr. B. Lange, of the Kaiser Wilhelm Institute for Silicate Investigation. Previously this has not been possible. The new cell, the essential part of which is a "sandwich" of copper oxide between two layers of metallic copper, may also prove a revolutionary improvement in talking movies and television and in many phases of scientific work.

Ordinary photoelectric cells, consisting of a layer of a metal such as potassium inside a glass bulb containing either a vacuum or a small amount of inert gas, can only be operated with an auxiliary source of electric current. When light falls on the potassium layer, electrons are given off. When connected to a battery, or other source of current, the electrons are carried to another metal plate or wire which forms the other electrode. Thus, the flow of the current is regulated by the amount of light falling on the potassium layer.

In Dr. Lange's cell, the light falls on one of the thin copper layers and the electrons are driven off. They pass through the copper oxide layer, which is exceedingly thin, only a few layers of molecules in depth. When they reach the other layer of copper an electric current results. Because of the short distance through which the electrons have to travel, the cell operates without the slightest appreciable lag. The current given off is

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powerful enough that when a rapidly flickering light shines on the cell, the current can be fed into a loud-speaker and a note vibrating at the same rate as the light can be heard.

Other advantages of the copper cell are that it does not show fatigue as does the ordinary type, it can be operated indefinitely without loss of efficiency and it is much more sensitive to the infra-red waves, too long to be visible.

In round numbers, Dr. Lange estimates, his new cell is ten times as efficient as the older types. But by the proper adjustment of the middle layer, and the use, perhaps, of other materials than copper oxide, he foresees the possibility of increasing the efficiency still further and converting light directly into large quantities of electricity. Even as constructed at present, the cell should prove a radical improvement in talking movies and television. It will also, suggests Dr. Lange, be useful as a photometer, to measure light intensity, because the current given off is directly proportional to the light falling on it, over a long range of brightness.

ITEMS

THE vital hormone of the cortex of the adrenal gland has been obtained in an extract called cortin, Professor F. A. Hartman and Dr. K. A. Brownell, of the University of Buffalo, reported to the American Physiological Society. The adrenal gland has two parts, one of which, the cortex, is essential to life. When the adrenal cortex is destroyed by disease or accident or removed by operation, the animal or man dies shortly. However, the Buffalo scientists stated that their extract will prolong the lives of animals whose adrenal glands have been removed so that they live from two and one half to three times as long as untreated animals without adrenals. The extract when properly made is harmless when injected into human beings. It has been given by mouth with beneficial results in some instances. The method of preparing it was briefly described in the report.

NEW knowledge of the vitamins was disclosed at the Chicago meeting of the American Society of Biological Chemists. Destruction of vitamin A by radiothorium was reported by Professor A. G. Hogan, C. L. Shrewsbury and Gerald F. Breckenridge, of the University of Missouri. This vitamin is important for promoting growth and for preventing eye disease. It is found in butter, cheese, eggs, spinach and liver. While the experiment was conducted with radiothorium, the inference is that any radioactive substance would have the same effect on this important vitamin.

EVIDENCE that the California condor, largest of flying birds, once ranged well to the east of its present habitat in California has been discovered in Conkling Cavern, N. M., the celebrated bone cave where human remains were recently discovered associated with fossils of extinct camel, ground sloth and other strange animals. One wing bone has been identified as that of a California condor by Dr. Hildegarde Howard, of the Los Angeles Museum, whither the bones from the cavern have been removed. In all, the cave has yielded about 100 bones of birds.

THE world's smallest opossum, a tiny animal no bigger than a mouse, is a native of Argentina. H. Harold Shamel, of the U. S. National Museum, who describes the new species in the *Journal* of the Washington Academy of Sciences, states that the specimen was collected some time ago by Dr. Alexander Wetmore, but that it remained unstudied in the museum until now. The little opossum is less than five inches from nosetip to tailtip, and nearly half its length is accounted for by tail. The specific name given it is *muscula*, which means "little mouse." There are many species of mouse which are larger.

CANADA would like to stop buying $3,000,000 worth of sulfur in the United States every year. An experimental plant for extracting sulfur from the mineral, iron pyrite, has begun operation in the hope of producing sulfur at a cheaper price than the import cost, Horace Freeman, chemical engineer, of Shawinigan, Que., told the Canadian Institute of Mining and Metallurgy meeting at Toronto. Canada must have sulfur to make the sulfite liquor used in her vast paper industries and to make sulfuric acid. Most of America's sulfur is now mined in Louisiana and Texas in a practically pure state. Combined with iron, as the sulfide or pyrite, it is found in large quantities very near Canadian paper mills, but in the past there has been no satisfactory method of extracting it.

EVEN if Americans are wasteful, as is often claimed, they salvage nearly a billion dollars' worth of their waste every year. This is according to figures of the U. S. Bureau of Mines on the amount of scrap and secondary metal recovered which is increasing every year. The waste trade industry is concentrating in large units. Even gold and silver is recovered in quantity from jewelry and dental waste. Photographic solutions contain half an ounce of silver to the gallon and 1,000,000 feet of waste movie film yield 800 ounces. Of the 500,000 tons of secondary copper recovered annually, part comes from 300,000 burned out electric lamps collected by one company. About forty per cent. of the annual supply of tin and lead has been used before. The iron and steel saved in a year is worth $500,000,000. Other metals salvaged in quantity from scrap, sweepings, skimmings and dross are mercury, zinc, antimony, aluminum and nickel.

HELIUM has been produced at the government plant at Amarillo, Texas, at a cost which compares favorably with that of hydrogen. More than a million cubic feet of the non-inflammable airship gas, of which the United States has a monopoly, was made during January for a net cost to the government of $9.64 the thousand cubic feet, according to a statement made by the U. S. Bureau of Mines, which built and operates the plant. Inflammable hydrogen, which is still used in lighter-than-air craft of other nations, can be made at costs varying from three to nine dollars the thousand cubic feet.

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THE ATLANTA MEETING OF THE AMERICAN CHEMICAL SOCIETY

THE South has profited immensely by the assistance of chemistry in industry, and it has thereby contracted a debt to the science which it can pay only by wholehearted encouragement and generous support of chemical education and research. This was the thesis of an address to the people of Atlanta given on April 3 by Dr. Harrison E. Howe, editor of *Industrial and Engineering Chemistry*. Dr. Howe has just finished an 11,000-mile survey tour, during which he visited numerous industrial plants, educational institutions and research laboratories where chemistry plays an important part in the program. He is convinced that now is the time when chemistry should be most strongly encouraged, not only for the speedier ending of the present industrial sag but for the upbuilding of the greater era of prosperity which is to follow. Dr. Howe pointed out that encouragement of chemistry does not imply merely the support of such branches of the science as promise immediate application. The employment of plant chemists and chemical engineers is now recognized as an integral part of good industrial management. What is more needed is a farsighted and public-spirited program of development in chemical research institutions and chemical departments of universities, with adequate, continuous support of fundamental work too often considered "merely theoretical" by those who should supply needed resources. All sound practice is based on sound theory, and there can not be advance in practice unless advance in theory pioneers the way for it. Much of this fundamental work that will pave the way for further industrial advances should be done in the South according to Dr. Howe. Irrespective of where competent chemists are trained, the laboratories where they will work will inevitably be more or less in the shadow of the interests and problems of the regions where they are located. It is therefore properly enlightened self-interest, as well as proper local patriotism, for Southern communities to bring up their own chemists in their own chemical laboratories.

THE meeting of the American Chemical Society opened on April 8 with a symposium on analytical chemistry, participated in by Professor H. H. Willard, of the University of Michigan; Professor George L. Clark, of the University of Illinois; C. C. Nitchie, of Palmerton, Pennsylvania; Dr. C. W. Mason, of Cornell University; Professor Victor K. LaMer, of Columbia University, and Professor Harry B. Weiser, of the Rice Institute. The old-time apparatus of analysis has not been abolished by any means, but rather improved in pattern and made of better materials. The chemist's glassware shelf now boasts a goodly proportion of pyrex and fused quartz wares, which are less soluble in strong reagents than glass, once the only material available. There are better filters and improved controls over temperature, humidity and other factors that influence the outcome of experiments. Where the older chemist needed whole ounces of material before he could make an analysis, his modern descendant can often get even more accurate results with a speck of stuff no bigger than a pinhead. He puts the material to be analyzed under a microscope instead of into a test-tube, and through the magic eye of that instrument sees the effects of the reagents he applies multiplied a thousand-fold. Watching rainbows used to be the most visionary of occupations, but the modern chemist, watching through his spectroscope the glowing streaks given off by an ignited "unknown," can dissect its chemical makeup as accurately as the anatomist with his scalpel can take apart a fish or frog. Beginnings in spectrum analysis were made long ago, but these were only qualitative: they told what was in a given sample of material, but did not answer the question, "how much?" which is basic to all industrial processes as well as to a great deal of "pure" chemistry. Now the magic rainbow-tube of the chemist is beginning to be able to weigh the parts of the things it is called upon to analyze.

CHANGING one chemical element into another by the action of a third element and in the process obtaining two still different elements is the atomic juggling described by Dr. William D. Harkins, of the University of Chicago, and Dr. Arthur E. Schuh, of the Bell Telephone Laboratories. The experimenters were not able to obtain changed elements in any useful quantities, but have been working with single atoms, observed by the indirect process of watching the cloud of fog they leave behind them as they dash through a chamber containing water vapor at low pressure. Nitrogen, the element that makes up some three-quarters of the air we breathe, was what they started out with. It was bombarded with alpha particles—nuclei of helium atoms given off by thorium, an element like radium, while disintegrating into another element. There is no way of aiming the atomic bullets, but after a long enough series of trials, an occasional hit may be scored. Dr. Harkins and his associate studied nearly half a million tracks of atoms, and only found two that showed evidence of a disintegration of the atoms into another element. Here is the complicated series of events they believe to take place in the instant of time that the change requires: The alpha particle, or helium nucleus, attaches itself to the nucleus of the nitrogen atom. It thus becomes the nucleus of an atom of fluorine. In less than a millionth of a second, however, the fluorine nucleus emits a fast hydrogen particle, or proton, part of the atomic nucleus. The remaining part is the nucleus of an oxygen atom of mass 17. Ordinary oxygen has an atomic weight of 16, but it has a variant, or "isotope" of atomic weight 17.

THE chemical riddle of the common cane or beet sugar has been solved by a research worker in the U. S. Hygienic Laboratory at Washington, Dr. C. S. Hudson, who told how the cane sugar molecule—called "sucrose" by chemists—is put together. It has long been known that the sucrose molecule is made up of 12 atoms of carbon, 22 atoms of hydrogen and 11 atoms of oxygen, expressed in the formula: $C_{12}H_{22}O_{11}$. But how these 45 chemical building-blocks were arranged nobody knew; and the

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possible combination of 45 atoms in space, even with the limits imposed by chemical laws, made it not much use guessing. Dr. Hudson preferred not to guess. He experimented. The first step was the discovery that under certain chemical manipulation sucrose breaks down, yielding two other common sugars. One of these is dextrose or glucose, which is now made by millions of pounds from cornstarch. It is not so sweet as sucrose. The other product of the breakdown is levulose or fructose, much sweeter than sucrose. This sugar has been produced on a large-scale experimental basis. The problem remained as to how these two sugars, whose structures were already fairly well known, were arranged in their modified combined form in cane sugar. This is the accomplishment reported by Dr. Hudson.

THERE is radium in Stone Mountain, the famous dome-shaped mass of granite near Atlanta that has been chosen as the site of a titanic monument to the heroes of the Confederacy. If it could all be extracted, it would be worth over 120 million dollars. But it will never be extracted, for in spite of its value in the mass, the rock constitutes too low-grade an ore to be worth working. What can be extracted from Stone Mountain, however, is scientific information worth eventually many times the fabulous 120 millions. When its geochemical secrets are fully read and compared with readings yielded by other stones, scientists will know much more about the age of the earth than they do now, and more about where the interior energy comes from that helps to keep the earth warm, and maintains a layer of melted rock some miles beneath the surface, between the solid crust above and the solid core below. A few preliminary paragraphs of the story which Stone Mountain may be expected to tell were related before the society by Dr. Charles S. Piggot, of the Carnegie Institution of Washington. His first analyses of the granite of the mountain show that it contains from four to eight times as much radium as granites and other rocks obtained from a number of other widely separated places, ranging from North Carolina to Greenland. At that, it contains very little. One gram, or about one-thirtieth of an ounce, of the rock has less than one four trillionth of a gram of radium in it. Only one other rock sample contained approximately the same concentration of radium. This came from North Jay, Maine, from a formation believed to be similar in its origin to Stone Mountain. Stone Mountain is made out of granite formed into a mass deep under the earth, which was afterward slowly eroded away from it, exposing it above the surface. Such a mass is known to geologists as a "batholith." Whether all batholithic rock will show a high concentration of radium, as compared with the low concentrations which Dr. Piggot found in his other rocks, all of which came from nearer the surface, is still a matter for speculation.

PROFESSOR ARTHUR F. BENTON and T. A. White, of the University of Virginia, reported on some new things they have learned about the way catalysts act, especially at very low temperatures. They worked with finely divided nickel, which is one of the most widely used of catalysts, and hydrogen, one of the commonest of industrial gases, at temperatures ranging as low as 220 degrees below zero Centigrade. The volumes of the gas adsorbed to the nickel under the conditions of the experiment led the chemists to the conclusion that adsorption takes place in two stages. In the primary stage the metal sheathes itself in a layer of gas molecules to the thickness of one molecule. When this envelope is complete, the gas molecules are more highly "activated," that is, more ready to combine into new compounds, than at any other time. Before the layer is complete, the catalyst may attract and hold patches of gas molecules, but they are too tightly held to be available for combination purposes. After the layer is complete, other secondary layers may form outside it, but these appear to be less under the influence of the catalyst and are therefore more indifferent to opportunities for forming combinations.

A NEW gas for the coils of electric refrigerators was demonstrated. It is non-poisonous and non-inflammable, and it very closely approaches the refrigerating engineer's notion of an ideal substance for the purpose. The new gas is a compound of carbon, chlorine and fluorine, and is a chemical cousin to carbon tetrachloride, widely sold under a variety of trade names and used for such diverse purposes as grease-spot remover, fire extinguisher and insect exterminator. As a matter of fact, carbon tetrachloride is one of the two ingredients that are used in making it, the other being a less-known compound, antimony fluoride. The new refrigerant is the invention of Thomas Midgley, Jr., the developer of ethyl gasoline, and a Belgian chemist, Dr. A. L. Henne. The work was done in the laboratory of one of the large electric refrigerator companies at Dayton, Ohio. The new gas is as completely non-toxic as carbon dioxide. Animals kept in an atmosphere containing a considerable percentage of the new refrigerant showed no signs of distress or illness. It is also completely non-inflammable.

THE largest nitrogen fixation plant in the western hemisphere, which greatly increases the industrial and military independence of the United States, was described by Professor Lauren B. Hitchcock, of the University of Virginia. This plant converts daily 350 tons of inert nitrogen gas of the atmosphere into sodium nitrate and anhydrous ammonia for peace-time industrial uses. But if the United States were at war, the plant would largely free her of the necessity of getting Chile saltpeter from South America for fertilizer, explosives and essential chemical industries. The plant is a splendid example of the application of recent refinements in process, the speaker said. Application of the latest technology is necessary in order that the synthetic material may compete with the Chile product dug from the surface of the ground. It is situated at Hopewell, Virginia, on the James River, eighty miles from Hampton Roads.

PLANS of the U. S. Bureau of Mines to assist American industry in getting the best value out of every dollar's worth of coal were laid before the society by Dr. A. C. Fieldner and J. D. Davis, of the Bureau of Mines staff. The time is long since past when all you could do with coal was burn it. All coals susceptible to the coking process are baked now before they are burned, and valu-

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able liquids and gaseous ingredients are extracted from them. But coking coals from different mines have different properties, and a temperature or time of treatment good for one kind might be bad for the next. For this reason a systematic survey is being made of all the coking coals in the country, so that complete data may be available for any one who may be able to make use of it.

RESEARCH has made possible the production of a large portion of the annual turpentine and rosin yield in the southeastern states from pine stumps instead of full-grown trees, according to Brian S. Brown, of Savannah, Georgia. Early methods practiced until the beginning of the present century were fatal to trees. Then the external cup to catch the gum replaced the internal cut. Now improved methods of chipping trees, increasing fire protection and rapid growth of slash pine insure practically unlimited future supplies of rosin and turpentine.

GOOD food for human beings will come from parts of cotton seed now fed to cattle and hogs, or even wasted. So predicted a New York chemist, David Wesson. "A cotton crop of fifteen million bales furnishes the oil mills with five million tons of seed. This seed produces, under present methods of manufacture, 308 pounds of oil per ton of seed, or 13 pounds of fat for each inhabitant of the United States. Improving manufacturing methods would yield 20 per cent. more oil and allow the utilization of the 900,000 tons of protein present in the seed for human food, supplying approximately one half the protein needs of the country. Experiments made on a semi-commercial scale show that these results are possible."

SALMON oil, now looked upon as a fisheries by-product of no great value, is a good source of the rickets-preventing vitamin D, now considered essential for the raising of chicks and other young animals as well as for the proper rearing of children, according to E. M. Nelson, of the U. S. Department of Agriculture, and J. R. Manning, of the U. S. Department of Commerce. A number of oils from commercially handled fishes were tried out, and it was discovered that salmon oil, though not the most abundantly produced of these, is nearest to cod-liver oil in its vitamin D concentration. As extracted by the present methods, which are not especially good from the vitamin standpoint, salmon oil is about equal in potency to the poorer medicinal grades of cod-liver oil. Since the potential supply of salmon oil is five times as great as the present domestic supply of cod-liver oil, these findings are regarded as significant.

THAT there can be too much of a good thing has been demonstrated anew by a New York biochemist, R. F. Light. He fed to experimental animals heavy overdoses of vitamin D, the substance that prevents rickets. In this overdosage it carried its preventive activities too far, making it impossible for the animals to reproduce their species after the second generation. Other studies in vitamin overdosing were carried out by Mr. Light in collaboration with G. E. Miller and C. N. Frey. In these it was found, among other things, that too much vitamin D produces a condition resembling pellagra, which could be delayed, though not prevented, by the administration of vitamin G, the pellagra preventive vitamin.

GLOSSINESS of paints can now be measured without regard to their color, with a new instrument described to the paint and varnish chemists at Atlanta by George S. Haslam and Lester D. Grady, Jr., of Palmerton, Pennsylvania, who stated that "The value of the glossmeter lies in its ability to give a result that is independent of the color and brightness of the sample and in giving a numerical value for gloss so that the loss of gloss on aging can be followed."

ALTHOUGH the manufacture of artificial silk and wool has increased enormously during recent years, the production of the synthetic fibers in 1929 was less than four per cent. that of the natural fibers according to Professor Charles E. Mullin, of Clemson College. He also predicted that the 1930 output of synthetic yarns will exceed the million and a quarter pounds of last year by more than 30 per cent., and he added that the saturation point to-day is as far off as it was 10 years ago. Chemical research was cited as being largely responsible for developing the new processes of manufacture and then opening up new uses and outlets for the products. "As compared to the wonderful progress in this industry, the rest of the textile industry has been standing still, rooted in its own ignorance of the fundamentals involved in every step in all its manufacturing processes."

SOME of the principles of distillation were known in ancient times, and in the heyday of the alchemists, during the sixteenth and seventeenth centuries, these ancestors of the modern chemist knew almost all of the tricks in the trade. So Gustav Egloff and C. D. Lowry, Jr., of Chicago, pointed out before the chemical education section. The alchemists did not waste all their time hunting for such fabulous things as the philosopher's stone. They were a practical lot of artists, though their scientific knowledge was sketchy in some departments, and they used apparatus that often had a decidedly modern look for the distilling of all manner of objects, including wood, ores, aqueous and spirituous liquids, flowers and herbs.

EUROPE was not the only region of the earth where alchemists plied their secretive trade and marketed their often spurious discoveries. In China, too, this half-disreputable ancestor of chemistry reared its head, so long before European alchemy came into being that Chinese alchemy may well be the ancestor of all the Occidental alchemies. So the division of the history of chemistry of the American Chemical Society was told by Professor Tenney L. Davis and Lu-Ch'iang Wu. Alchemy seems to have arisen spontaneously in China, where it was certainly in existence as early as the second century B. C. The Chinese alchemists attempted to transmute base metals into gold and to prepare the elixir of immortality. They worked with the same materials that were used by the later Greek, Arab and European alchemists.

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SCIENCE NEWS

Science Service, Washington, D. C.

THE ORBIT OF "PLANET X"

DOUBTS that the new member of the solar system discovered beyond Neptune is the ninth major planet predicted by the late Professor Percival Lowell have been raised by computations of its orbit made at the Lowell Observatory, Flagstaff, Arizona, where the object was discovered, and reported in a telegram on April 13 by Dr. V. M. Slipher, the director.

While the position of the object, it was stated at the time of announcement of the discovery a month ago, seemed to conform to the expected orbit of the "ninth planet," it is now thought that it may be proved to be a unique asteroid or an extraordinary comet-like object.

Dr. Slipher reports that the "preliminary orbit of planet X" was computed by the Lowell Observatory staff with the aid of Dr. John A. Miller, director of the Sproul Observatory, using positions of the object on January 23, two days after it was first photographed, February 23 and March 23.

The computations give the eccentricity as slightly more than .9, meaning that the object sweeps through space in a greatly elongated ellipse, far flatter than the orbit of any known planet and more like that of a comet. The object's path is far more inclined to the plane of the earth's orbit than any major planet, the calculated inclination being 17 degrees 21 minutes.

Dr. Slipher reports the distance of the object from the sun as 41.3 times that of the earth. This is about the distance predicted by Professor Lowell for his "planet X."

The greatest diameter of the object's orbit exceeds by 40,000,000,000 miles that in its position closest to the sun. This is far greater than any distance hitherto measured within the solar system. The object has just begun to recede from its closest approach to the sun.

Dr. Slipher's report conforms to an announcement of an orbit computed by A. C. Bower and F. L. Whipple under the direction of Professor A. O. Leuschner, of the University of California Observatory at Berkeley. Professor Leuschner telegraphed:

"The Lowell result confirms the possible high eccentricity announced by us on April 5. Among the possibilities are a large asteroid greatly disturbed in its orbit by close approach to a major planet such as Jupiter, or it may be one of many long-period planetary objects yet to be discovered, or a bright cometary object.

"I have frequently referred to the close orbital and physical relationship of minor planets and comets. High eccentricity and small mass would seem to eliminate object as being planet X predicted by Lowell, and signify an unexpected discovery, nevertheless of highest astronomical importance and interest on account of the great distance of the object in the solar system at discovery."

Dr. Harlow Shapley, director of the Harvard Observatory, wired:

"The preliminary orbit indicates remarkable type of member of the solar system not comparable with known asteroids and comets, and perhaps of greater importance in cosmogony than would be another major planet beyond Neptune."

GRAVITY MEASUREMENTS AND ACCURATE MAPPING

EXACT determination of the force of the earth's attraction now in progress at the U. S. Bureau of Standards will make the United States independent of Germany in a few years in knowledge of how hard the earth pulls things toward it. Speaking on April 5 in a *Science Service* radio talk over the Columbia Broadcasting System, Dr. Paul R. Heyl told of the work, which is under his charge. Dr. Heyl's determination during the last few years of the "constant of gravity," from which scientists calculate the mass, or "weight," of the earth, is the most accurate that has yet been made.

The new measurement of the absolute value of gravity is being made to an accuracy of within one part in a million. It will help the surveyors of the Coast and Geodetic Survey to map the country more accurately than before.

"The surveying of large areas differs from small-scale work in that the curvature of the earth must be taken into account," Dr. Heyl explained. "It is not sufficient to assume that the surface is spherically curved, even on the Great Plains. One of the best ways of determining the change of curvature of the earth's surface is by the variation in the pull of gravity at different places. Where we are farther from the earth's center, the pull of gravity is less. But since such departures from spherical form are always very small compared to the size of the earth, we must be able to measure gravity very accurately indeed if the results are to be useful.

"Determinations of gravity are made throughout the United States on a comparative or relative basis, with reference to a base station, where the value of gravity should be known to as high an accuracy as possible. While it is a comparatively simple matter to compare different values of gravity with one another it is quite another thing to determine the absolute value of gravity at the base station.

"It happens that our Coast Survey has never had a real base station for gravity in this country. The measurements throughout the land have been compared, it is true, with the value of gravity at Washington, but the value at Washington traces its pedigree from the absolute gravity station at Potsdam in Germany. It is by no means as simple a matter as it appears to extend comparisons of gravity across the ocean, and without a base station of our own we are not quite sure of our ground. The experiments now in progress at the Bureau of Standards are for the purpose of establishing such a base station in our own country."

One very practical use of gravity measurements is in locating valuable deposits of oil and minerals.

"The pull of gravity may vary because of the nature

Revised--GENERAL CHEMISTRY

By **HARRY N. HOLMES**, *Professor of Chemistry, Oberlin College*

AFTER seven or eight years a revision of any text on Chemistry must be radical, and this second edition of Holmes' GENERAL CHEMISTRY is a very genuine revision, with new material introduced throughout. It is larger by about a hundred pages than the previous book, and differs more markedly than before from the author's INTRODUCTORY COLLEGE CHEMISTRY.

A few entirely new chapters have been added, such as the one on Photochemistry. This is not simply a study of photography, but deals broadly with the chemical effects of all sorts of radiations, a subject of rapidly increasing importance. Another new chapter takes up Nitrogen Fixation. New material has been interspersed throughout the text.

The treatment of certain difficult subjects has been clarified and the entire content has been thoroughly modernized. Industrial applications dated to the last minute make a strong appeal to the student.

Important changes in the order of treatment have been made. Radioactivity is treated early in the book in connection with the periodic system as a logical foundation for a discussion of modern theories of atomic structure. While using modern conceptions of the atom, the author makes it clear that our present theories of atomic structure are constantly subject to modification.

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of the material beneath the surface at different places." It is possible that "there may be underground a large body of rather heavy rock, or again there may be a deposit of oil, very much lighter than the average crust of the earth, and consequently less attractive (from a gravitational point of view). Many an oil well has been discovered in this way; but it will be obvious that if the deposit is very deep it will require great precision in our gravity measurements to detect its presence."

The measurements are made with a very accurate pendulum. Both its length and the time it takes to swing can be measured with great accuracy. For the same length of pendulum, the greater the force of gravity, the more quickly does the pendulum oscillate.

THE PRODUCTION OF XYLOSE

XYLOSE, a sugar made from woody stuff, may come to figure as largely in American industry as its chemical cousin cellulose now does. A commercially practicable means of manufacturing it out of cottonseed hull bran, now a very low-value byproduct of the cottonseed industries, has been worked out at the U. S. Bureau of Standards and was discussed before the meeting of the American Chemical Society by one of the group of scientists who developed it, Dr. W. T. Schreiber.

Although xylose has almost the same chemical makeup as glucose, lactose and other food sugars, it is not expected to play its most important rôle as a food. It can be fermented into a variety of materials useful in industry, especially alcohol and such solvents as acetone, lactic acid and acetic acid. By other manipulations it can be turned into a basis for dyestuffs and food colors. Transformed into an allied substance, xylite, it may be treated as cellulose is treated to make guncotton, resulting in a new explosive which might be called nitroxylite.

Although the possible use for xylose as food is not large in bulk, it may be important nevertheless. It is not as sweet as common cane- or beet-sugar, but it has a definitely sweetish taste, and it may therefore turn out to be useful in the diet of diabetics, who can not tolerate ordinary forms of sugar. Xylose appears to be harmless to diabetics.

Xylose has been an expensive laboratory possibility for a long time, but its preparation from agricultural waste on a large scale makes it an important industrial novelty. The Bureau of Standards group that developed it includes S. F. Acree, who originated the present process for its manufacture, W. L. Hall, Max Bradshaw, Fred Acree, W. T. Schreiber, Klare Mackley, R. C. Geib, W. Eckhardt, Baker Wingfield, C. S. Slater and G. M. Kline.

THE REACTION OF PLANTS TO COLOR

ALTHOUGH plants have no eyes to see with, they can distinguish between different colors of light, and they paradoxically indicate their choice by bending toward the radiation that they find hardest on their growth. This preference by plant protoplasm is being explored by investigators at the Smithsonian Institution as a part of a program of research on the influence of radiation on living things sponsored by Dr. Charles G. Abbot, the secretary.

The group immediately concerned with the work is led by Dr. F. S. Brackett, physicist, and Dr. E. S. Johnston, plant physiologist. In one of the laboratory rooms they have arranged a dark chamber with an electric lamp at either end, its light passing through a color screen. A young plant is placed between the two, at a point where the energy of the opposing light-beams has been instrumentally determined as being exactly equal.

The plant thus finds itself in the position of the donkey exactly midway between two haystacks, which medieval philosophers are said to have argued about. Which will it choose? The way out of the dilemma is as though the donkey had found himself between a stack of timothy hay and one of clover: there is a qualitative choice. All kinds of visible lights seem to have a retarding effect on plant growth, but some have more than others; and the plant grows less on the side exposed to the more growth-retarding of the two beams, and therefore grows toward it, being pushed over by its more rapidly-growing side.

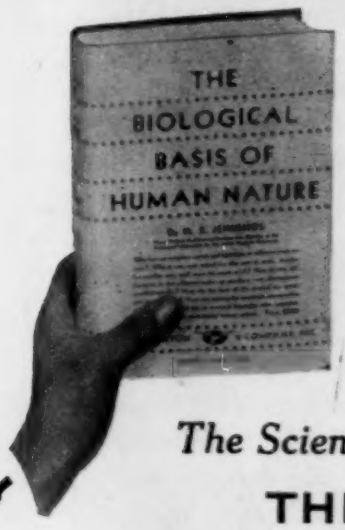
Red light, and the short-wave infra-red, the Smithsonian experiments have shown, have very little effect on growth. Yellow light still has little effect, though more than red. But the green sector of the spectrum has a powerful influence, and the blue-violet group of wave-lengths is stronger still in causing growing plant-tips to bend.

The work, Dr. Brackett informed *Science Service*, is still in its preliminary stages, and only broad groups of wave-lengths have so far been used. Apparatus is now being made that will enable the experimenters to split white light up into much more finely subdivided individual beams, and thereby make possible a much more exact test of the effect of each separate wave-length throughout the spectrum.

The research on the color likes and dislikes of growing plants is only a small part of the work projected by the Smithsonian Institution. Eventually the experimenters hope to get at some of the secrets of the mechanism by which the chlorophyll of green leaves uses sunlight to combine carbon dioxide and water to make sugar. But the barest beginnings of an understanding of the structure of these complex living molecules have yet to be worked out, and while the attack on this stubborn citadel of mystery is being organized, other problems, like that of the effect of light on growth, can properly be undertaken.

FUNGI AS A CAUSE OF BLUE STAIN IN TREES

BLUE stain is one of the most troublesome of timber ills in the South. A variety of it that attacks trees is found to depend for its entrance on an insect, one of the bark beetles, in somewhat the same way as malaria and yellow fever have been traced to the guilty germ-carrying activities of mosquitoes. Blue stain is due to the growth of certain fungi which discolor the wood and lower its market value; and it now appears that some of these organisms are active agents in the killing of pine trees.



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The hooking up of the bark beetle and the blue stain fungus, each of which has been well known for some time as a serious pest in its own right, has been the work of three scientists in the U. S. Department of Agriculture, Dr. F. C. Craighead, R. M. Nelson and J. A. Beal. Dr. Craighead called especial attention to the fact that an onset of blue stain in a tree almost invariably followed a mass attack by small beetles, of the genus *Dendroctonus*, boring holes through the bark and mining galleries in the living inner bark tissue in which to lay their eggs. The blue stain started from these borings and in a short time the tree died, presumably through the choking up of the sap-carrying tubes in the wood.

Mr. Nelson and Mr. Beal demonstrated that the blue stain fungus can be planted in the wood of the tree through wounds, such as the bark beetle bores. They made artificial cultures of the fungus on sterilized rice paste, and brought this paste into contact with the wood of undiseased trees in various ways. From some trees they removed squares of bark, replacing them with poultices of the culture-paste. Other trees had holes bored in them and filled with the paste, and in still others the paste was planted by means of a grease gun. Typical blue stain infections developed as a result of all three types of inoculation.

Whether the association of bark beetles and blue stain is accidental, or whether the beetles get any benefit from the fungus, is something not yet determined. Dr. Craighead has pointed out that other beetles belonging to the same zoological group depend entirely for food on certain fungi that grow in their burrows. Or it may be that the benefits derived by the bark beetles are less direct; perhaps the best conditions for rearing their young are found in trees of just the stage of "deadness" induced by the fungus.

ITEMS

Two new diseases of potatoes, known as "Crinkle A" and "Para-crinkle," were described before a recent meeting of the Royal Society in London by R. N. Salaman and R. H. Le Pelley. Both diseases are related to such known plant ills as leaf mosaic, in that they are caused by filterable viruses, organisms so small that they pass through the pores of fine porcelain filters, and can not be detected with the highest powers of the microscope.

The conjecture that the direction sense or homing instinct of birds is connected in some way with their sex glands has received a setback at the hands of two Dutch ornithologists, G. J. van Oordt and C. J. A. C. Bol. They tried the simple experiment of releasing carrier pigeons which had been surgically unsexed. The birds found their way to the home loft as quickly and easily as did normal pigeons.

Calcium gluconate, a chemical made by the action of moulds once thought good for nothing but spoiling things, is a valuable addition to the feed of milch cows, it was reported to the American Chemical Society on April 9. The report was based on experiments conducted by W. A. Turner, E. A. Kane and W. S. Hale, of the U. S. Department of Agriculture. Calcium gluconate is a compound of gluconic acid, which is now made experimentally in quantities in the Department of Agriculture laboratories at Arlington, Virginia. A few years ago it was worth over $100 a pound, when it could be had at all; now its cost is down to about 35 cents a pound. This makes possible experiments looking toward its eventual practical use. The calcium gluconate was added to the feed of the cows as a possible source of additional lime for their blood and also for their milk. Lime salts are among the valuable mineral constituents in milk, especially in milk fed to young children.

Before the section on chemical education of the American Chemical Society, R. G. Woodbridge, of the du Pont company, told of the conversion of millions of pounds of surplus powder left over after the war into finishes useful in the arts of peace. The nitrocellulose base of smokeless powder is so close chemically to the new cellulose lacquers that such a conversion is easy and practicable. Mr. Woodbridge also told his hearers that if the war had not ended when it did, the 1918 crop of short-staple cotton would not have sufficed to supply the needs of America and the Allies for explosives, and that wood-pulp would have had to be used to supplement it. During the war only the Central Powers, their cotton supply cut off by the blockade, were forced to use wood-pulp in the making of smokeless powder.

As clocks punched by watchmen indicate that the rounds have been made at the right times, so the tactograph, a new instrument used on railway locomotives, tells whether the engineer has properly driven his iron horse over the run. Did he exceed the safe speed trying to make up time? Were the curves taken too fast? Were delays the fault of time allowance, roadbed or rolling stock? What was the average speed for the run? The instrument is mounted in the cab of the engine and is geared to the axle like an automobile speedometer, *The American Machinist* explains. Speed at any time, length of stops and slippage are shown on a record sheet.

How medical and psychological examinations have been given to motormen with good and bad traffic records was reported on April 12 by Dr. O. M. Hall, of the Personnel Research Federation, speaking before New York members of the American Psychological Association. Among the men who had high-accident records, 39 per cent. were found to have personality defects, the psychologist reported. That is, these men did not get along smoothly with other people. Among the men with superior records for keeping out of trouble only 5 per cent. were found to be "un-cooperative." Forty-nine per cent. of the high-accident motormen were found to have health defects, chiefly abnormal blood pressure and hernia. This was contrasted with only 9 per cent. of the low-accident motormen having such health defects. Aptitude for the work of running a car was also tested, and it was found that 40 per cent. of the drivers who ran into trouble made poor records on this test, whereas only 12 per cent. of the safe drivers showed lack of aptitude for the job.

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(cf.—Osborne & Harris, Jr. Am. Chem. Soc., 25-IV, 346)

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SCIENCE NEWS

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THE ECLIPSE OF APRIL 28

ASTRONOMERS in the air above and on the earth below will watch the eclipse on April 28, along a path crossing California. Even though the eclipse at best will only last about a second and a half, elaborate preparations have been made to observe it. In addition, thousands of sightseers will journey to the half-mile-wide path to see this most impressive of all natural phenomena.

The time being so short, some of the usual eclipse observations will not be possible. Astronomers often travel half way around the earth to watch an eclipse, but it is probable that if this one were in Kamchatka or Timbuctoo they would pay little attention to it because it would hardly be worth the trouble and expense required to observe it. But as it occurs in California, within a few hundred miles of two of the world's greatest observatories, its observation is imperative. Were they to neglect an eclipse so near home, it might be difficult to get funds when there is an eclipse expedition to a more distant place in prospect.

However, valuable observations will be possible at this eclipse, despite unfavorable conditions. The corona, outermost layer of the sun, is visible only at a total eclipse and must be observed at every possible opportunity. A long exposure photograph, of many seconds, will be impossible, but a brief exposure will reveal its brighter features. With the path of the eclipse so narrow, and an uncertainty as to its exact position, of perhaps an amount equal to its width, there is a danger that a camera placed in the expected path might actually be outside. Ordinarily, when the path is a hundred or more miles wide, an uncertainty of a half mile or so at the edge is not serious.

On account of this, the astronomers from the Lick Observatory, at Camptonville, in Yuba County, under the direction of Dr. J. H. Moore, will have three corona cameras. One will be placed in the center of the predicted path, a second a third of a mile to the north and the third an equal distance to the south. Then if one camera misses, another would probably get it, and a valuable record will be obtained.

Near the Lick party will be a private group, under the direction of Dr. R. L. Waterfield, of the Johns Hopkins University. They will also try corona photographs. Farther north, near Honey Lake, in Lassen County, will be a party from the Mount Wilson Observatory, under the direction of Dr. S. B. Nicholson. Near-by will be Mrs. Isabel Lewis, as unofficial representative of the U. S. Naval Observatory, who will also try for corona photographs.

Circling overhead at various parts of the path will be army and navy airplanes, making photographs of the eclipse. Dr. Hamilton M. Jeffers, of the Lick Observatory, will fly in an army airplane from Crissy Field, San Francisco, while a group of naval planes will operate in the Honey Lake region. Besides photographs of the eclipse, they will try to photograph the shadow of the moon on the earth below. Such pictures, if they can be made at all, can probably be made even if the airplane is not in the exact path, but a little outside of it. With the slight uncertainties of navigating an airplane several thousand feet high along a precise path added to the uncertainties of the path itself, these aviators have a good chance of missing the eclipse. But with a fleet of planes, flying along a path a mile wide, one or two are pretty sure to succeed.

There is one eclipse observation, however, that will be made from the ground that is not dependent on the length of the eclipse. Just before or just after the sun is completely covered by the moon, the reversing layer, the outermost part of the sun as we ordinarily see it, can be observed by itself. The solar spectrum at such an instant appears as a series of bright lines, instead of the usual continuous colored band crossed by dark lines. This is called the flash spectrum. As it can only be observed at the beginning or end of a total eclipse, the duration is of little importance, and so this eclipse is just about as good for it as any other. Indeed, the flash spectrum is the chief justification for the eclipse observations. Efforts to record it will be made by the parties from the Lick and Mount Wilson Observatories, Dr. Waterfield's group and also by a group near Gerlach, Nevada, headed by Dr. Heber D. Curtis, director of the Allegheny Observatory at Pittsburgh.

Even outside the path of totality there will be some observations. At the Lick Observatory the eclipse will be about 98 per cent. total, and it might even be possible to secure a flash spectrum picture there. At the Students' Observatory of the University of California, in Berkeley, it will be still more nearly total and similar observations will be made.

WAVES AND PARTICLES

ONE of the outstanding puzzles of modern physics—how electrons, once thought of as material particles, can behave sometimes like waves while "waves" of light sometimes behave like particles—was discussed at a recent meeting of the American Philosophical Society in Philadelphia by Dr. C. J. Davisson, of the Bell Telephone Laboratories. One result has been that the physicist no longer tries to imagine a model of every physical phenomenon.

"The theoretical physicist has outgrown the ambition of Lord Kelvin," he said. "He no longer tries to devise a mechanical model of every phenomenon. It has been discovered, in fact, that a certain esthetic pleasure is derived from dealing in calculations with symbols which evoke no mental picture whatever. In certain quarters a fetish has been made of this mental attitude."

Describing his own experiments, Dr. Davisson told how a stream of electrons aimed at the face of a crystal had behaved much as light does striking a mirror—most of

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them had been shot back at the same angle to the surface layer of atoms as they had approached.

"There is a strong and well-defined beam of regularly reflected electrons. This is a phenomenon which is not predicted and can not be explained if we insist on assuming that electrons are solely corpuscles much smaller than the individual atom, for to such corpuscles the surface of the crystal must appear not as a smooth plane, but as a rough and broken field.

"Picture the crystal built up of atoms, each of them enormous in size compared to an electron and each of them comprising a nucleus surrounded by a larger number of electrons rotating in closed orbits. Imagine now an electron plunging into this galaxy of planetary systems. It is obviously a comet. The simplest event which may ensue will be a comet-wise deflection of the electron in the field of some atom into which it happens to strike, and then a speeding away of the electron from the crystals without loss of energy. The direction taken by the departing electron would be determined by a number of circumstances, one of which would be the distance of the line of approach of the incident electron to the nucleus of the atom responsible for its deflection.

"If we regard the beam of incident electrons as a beam of waves instead of as a stream of particles," he continued, "then each wave-front of the beam comes in contact with all the atoms of the surface, and the regular reflection is explained, as in the case of X-rays, as the result of constructive interference among the coherent secondary wave trains scattered by and proceeding from the regularly arranged atoms of the crystal."

Dr. Davisson also explained other similarly paradoxical experiments. "Whether or not it is possible to achieve a unified conception of electrons in which these newly discovered wave properties appear consistent with their longer known corpuscular properties, or whether such an achievement is beyond the limits of thought is a matter which does not worry the experimental physicist so much as might be supposed. It used to be said that a physicist regarded light as a wave phenomenon on Mondays, Wednesdays and Fridays, and as a corpuscular phenomenon on the other days of the week. This statement must now be extended to include electrons, and modified, I think, to state that he regards light and electrons as both waves and particles on all days of the week. And it might be added that familiarity with this duality of properties is dulling his sense of its paradoxical nature."

FURTHER INVESTIGATIONS OF PARROT FEVER

THE U. S. Public Health Service's investigation on psittacosis, or parrot fever, which has been suspended for a month on account of sickness of many members of the Hygienic Laboratory staff who contracted the disease, will be resumed shortly at the Baltimore Quarantine Station, just outside the city of Baltimore, as announced by Surgeon-General Hugh S. Cumming.

Dr. George W. McCoy, director of the Hygienic Laboratory, and Dr. Charles Armstrong, who had been conducting the investigations until he fell a victim to the disease, are now making arrangements for the resumption of the work in the new location. The removal of this part of the Hygienic Laboratory's work was made on the recommendation of a special committee appointed by the surgeon-general to study the situation after eleven persons working at the laboratory had been stricken with the disease.

The fact that most of those who became ill had not been anywhere near the rooms where the psittacosis studies were going on, and had no contact with the infected parrots or with the cultures of the germs suspected of causing the disease, has added to the mystery and to the dangerous element of this particular disease.

The question of a carrier state was brought up in this connection, and will be investigated when the work is resumed at the Baltimore Quarantine Station. A virus which was obtained just before the work was suspended is thought to be the cause of the disease. Confirmation of this will be part of the work. The susceptibility of other species of birds and animals to this disease which attacks both man and parrots will also be studied.

At the time of suspending the parrot fever work, the entire Hygienic Laboratory was carefully fumigated. All the birds used in the studies were destroyed, but cultures of the virus have been preserved and will now be studied.

"RUSH" TREATMENT FOR HAY-FEVER

JUST when the tiny pollen grains from early-blooming trees are causing the season's first sneezes and sniffles among early hay-fever sufferers, comes word from London of a new and speedy method of treating these unfortunates. The method is appropriately called "rush" desensitization by its author, John Freeman, director of the department of clinical bacteriology at St. Mary's Hospital, London, in his report of it to the *Lancet*.

Earlier methods of treating hay-fever victims have been leisurely, Mr. Freeman pointed out. The treatments were begun long before the hay-fever season started, and were given once a week for a number of weeks. When treating sufferers for whom there was no off season, because their attacks were due to some constant irritant, such as hair or dandruff from a pet cat, dog or other animal, Mr. Freeman developed a more intensive method of treating the patients every day with gradually increasing doses of the desensitizing vaccine.

He finally developed the "rush" method which can be put through in from two to four days. The treatments are given every one and a half or two hours throughout a 14-hour day. The patient either goes into a hospital for them or has a trained nurse at home who can give the treatments and watch his condition carefully.

The first step in hay-fever treatment is to determine what plant or tree pollen or animal or food protein causes the trouble in the individual case. Some persons are sensitive to more than one such irritant. When the offending pollens and other proteins are discovered, they are injected into the patient in tiny but gradually in-

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creasing amounts until finally his system has become desensitized to them and can tolerate them in the amounts usually present in the air of his environment.

PATENTS ON PLANTS

By the terms of a bill now on the calendars of both House and Senate the originator of a new plant variety may apply for and receive a patent on his product just as if it were a machine or a chemical formula. The protection thus to be extended, however, will apply only to plants that can be propagated by asexual or vegetative means; seed-propagated plant varieties, even if new, are not included. A further exception is made in the case of plants propagated by tubers, because of the strong opposition of growers of certain classes of field crops.

A bill to give plant breeders patent protection has long been desired by horticulturists, among them the late Luther Burbank. As things stand at present, the originator of a new and valuable plant variety can reap a reward for his labor only by selling his first small stock of plants at a high price. Occasionally a good-sized fortune will be paid for a half-dozen strawberry plants, but this is a rare exception; usually the plant originator gets little or nothing. And even when he has been shrewd enough to build up a high bid for his little monopoly, the first price is all he ever receives. In a few years the plant is anybody's plant, like a patent-expired invention. It is to remedy this situation that the present legislation has been proposed.

The field covered by the proposed law is very wide. Among patentable plants will be new varieties of practically all fruit and nut trees, such as apples, oranges, cherries, pecans and walnuts; most small-fruits, including grapes, raspberries, strawberries and blueberries, and many ornamental shrubs, vines and perennial herbs, like roses, lilacs, wisterias, phloxes and peonies. Most field crops are unaffected, because they are seed-propagated or tuber-propagated.

Both Thomas A. Edison and Mrs. Luther Burbank have wired to Congress their endorsement of the bill. Edison states: "Nothing that Congress could do to help farming would be of greater value and permanence than to give to the plant breeder the same status as the mechanical and chemical inventors now have through the patent law. There are but few plant breeders. The bill will, I feel sure, give us many Burbanks." Says Mrs. Burbank: "Have just received welcome news of congressional activity looking to protection of plant breeders and producers of new fruits by patent. As you probably know, this was one of Luther Burbank's most cherished hopes. He said repeatedly that until the government made some such provision for insuring experimenter or breeder reasonable protection, the incentive to creative work with plants was slight and independent plant breeding would be held back to the great detriment of horticulture."

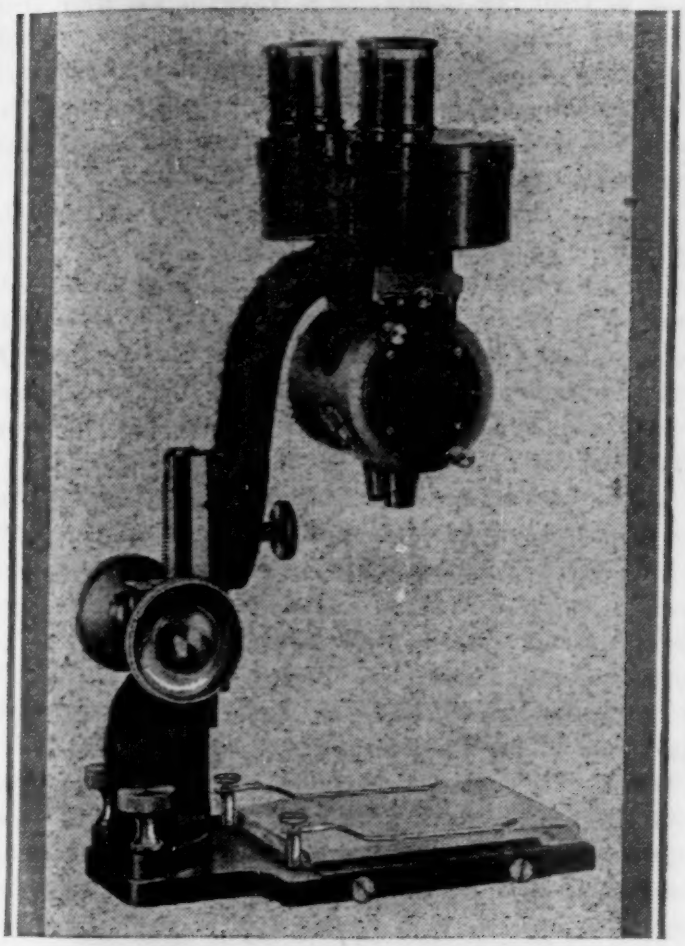
Commissioner of Patents Thomas E. Robertson stated that the amount of extra work which may be involved in administering the new class of patent claims has not yet been estimated by his office. For this reason, the bill as it stands carries no special funds for administration, but these will be asked for as needed. The bill provides that the Patent Office may receive the assistance of qualified plant scientists in the Department of Agriculture in passing judgment on the claims of applicants. The bill will not be retroactive if it becomes law. Plants that have been in public use for more than two years will not be subject to patent.

ITEMS

Two fragmentary human skulls, together with bones of two skeletons of prehistoric man, have been unearthed in Algeria by the Beloit College-Logan Museum expedition under Dr. Alonzo Pond. Thirteen student workers and 16 Arabs have started excavations at a site 12 kilometers north of Ain Beida and east of Berriche. Lauriston Sharp and John Gillen, both University of Wisconsin students, have come upon parts of an adult skeleton and the bones of a child about six years of age. The bones were found in an undisturbed section of a shell heap, which gives evidence that the individuals were as old as the deposit in which they were found. Numerous flints and some animal remains have been uncovered. Robert Kreiger, a Beloit student, found a human radius which had been used as a flaking tool.

Physical measurements have been made of over 6,000 old Virginians of both sexes between the ages of 6 and 60 years by Professor Robert Bennet Bean, of the University of Virginia. "The stature and leg length of the men and women are greater than for the majority of European peoples," Professor Bean reported at the recent meeting of the American Association of Physical Anthropologists. The tallest were the men of the group of planters, or gentlemen farmers, from Albemarle County, whose average height was approximately 5 feet, 11 inches. Next tallest were the group of men students.

Methods by which diameters of stars have been measured have been applied to the measurement of terrestrial distances with very high precision by Stuart H. Chamberlain, at the Michigan State College. In a report to the American Physical Society, he describes the method, which makes use of the interference of light waves. When a beam of light is separated into two parts and recombined under the proper conditions, a series of light and dark bands results, called interference fringes. Variation of as much as a small fraction of a wave-length of light in the distance traveled by one of the parts causes a perceptible shift in the bands. In the instrument developed by Mr. Chamberlain, a parallel beam of light is divided into two parts which, slightly separated, converge towards a mirror at the distance to be measured. This reflects them back to the observer, where they are combined by a prism and the fringes are seen in a telescope. Counts of the numbers of the dark bands tell the distance between the light source and the mirror.



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SCIENCE NEWS

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COSMIC RAYS

COSMIC rays, the invisible visitants from outer space that have been interpreted by Dr. R. A. Millikan as heralds of the creation of matter out of errant energy, do not come as steady, undulating streams after the manner of the older concept of light rays, but as separate, high-velocity particles, like tiny bullets.

This concept of the nature of cosmic rays has received support from the work of Dr. L. F. Curtiss, of the U. S. Bureau of Standards, who described his results before the recent meeting of the American Physical Society at Washington.

Dr. Curtiss placed two electron counters, instruments adapted for the detection of the swift passage of these almost infinitely small, electric particles, one above the other. Between the two he inserted the poles of a powerful electromagnet. It has long been known that electrons and other electrically charged particles can be pulled from their course by a magnetic field, and Dr. Curtiss reasoned that if the cosmic rays were corpuscular in their nature he should be able to deflect them after they had struck and registered in the first electron counter, and before they had made contact with the second.

This occurred: When the electromagnet was not in operation, the two electron counters would frequently register at practically the same instant. This was taken to indicate the impact of the same particle, as it passed through the two instruments successively. This interpretation was first applied by two German workers, Walther Bothe and Werner Kolhörster, the latter one of the pioneers of cosmic ray research.

But when Dr. Curtiss turned on the current in his electromagnet, the number of simultaneous registrations by his two electron counters was materially reduced, thus constituting a demonstration of the existence of a corpuscular radiation of very high energy.

THE BAER TREATMENT OF OSTEOMYELITIS

MOUNT ALTO VETERANS' HOSPITAL is to be made a training center for Veterans' Bureau hospital physicians learning the Baer method of treating the dangerous bone disease, osteomyelitis, with maggots, tiny larvae of flies.

Representative Royal C. Johnson, of South Dakota, who is chairman of the Veterans' Committee of the House, recently arranged for Dr. William S. Baer, clinical professor of orthopedic surgery at the Johns Hopkins University, together with his assistant, Dr. S. K. Livingston, to give a lecture with slides and demonstrations on his treatment before all members of the House Veterans' Committee.

Because doctors must be well trained before they go out to the hospitals and introduce this treatment, it was thought that the best plan was to make the Mount Alto Hospital a training center for doctors to learn the work at first hand. Mount Alto is staffed largely by Johns Hopkins men.

Appropriately enough the new method, which is to be used to treat the thousands of veterans suffering from this bone disease as soon as their physicians and surgeons can learn its technique, was developed as a result of observations made on wounded men during the war. Dr. Baer was then chief surgeon of the orthopedic section of the medical corps of the second army.

Treating the wounded as they came into the hospitals, he noticed that those who had been lying out on the fields for hours were brought in with their wounds covered by the tiny crawling maggots, the larvae from which common flies develop. But these men, strangely enough, did not develop infections in their wounds, as did those whose wounds had been dressed and treated very soon after their infliction.

After the war, Dr. Baer remembered the maggots when he was treating children suffering from osteomyelitis. This disease is an inflammation of the bone, more common in children than in adults. It is the result of an infection and requires prompt surgical treatment. It is also frequent in soldiers following wounds in which the bony tissue has been injured. Recovery is often delayed for years if the disease reaches the chronic stage. Dr. Baer remembered the maggots on the soldiers whose wounds healed quickly, and he remembered that the healers of ancient times had written that maggots should be used to clean up wounds of patients whose bones had been broken. He then started careful, scientific investigations.

The action of the maggots, Dr. Baer found, is to eat the dead tissues, bone and flesh, of the wounds and thus to destroy the material that would otherwise furnish good breeding ground for bacteria. The bacteria which might have entered a wound and set up an infection were unable to exist in the wound scavenged by the maggots.

The investigations had a number of setbacks. During the first winter, the supply of maggots gave out abruptly when cold weather killed the flies, and more had to be brought hurriedly from warmer cities than Baltimore. Then Dr. Baer started breeding maggots, so as to have a constant supply available. It was then found that the maggots occasionally caused fresh infection in the wounds. Much alarmed, Dr. Baer and associates attacked this new problem and soon found a way to breed maggots free from germs that could not possibly cause infection.

GROWTH PROMOTION AND INHIBITION

A THEORY of growth promotion and inhibition by means of organic sulfur compounds was explained before the Philadelphia meeting of the American Philosophical Society by Dr. Frederick S. Hammett, of the Lankenau Hospital.

In connection with his work on cell multiplication Dr. Hammett found the stimulus to cell division in the chemical group known as sulfhydril, consisting of one atom of

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sulfur and one of hydrogen, which attaches itself to a large variety of chemical bases, including many organic and living compounds. By applying various substances containing this sulfhydril group he succeeded in stimulating growth in various plant and animal tissues.

A practical application of this discovery has already been made in the medical field, Dr. Hammett stated. One of his colleagues has tried a sulfhydril compound on obstinate open wounds and sores of various types, and the resulting rapid growth of new tissue has brought about the cure of a number of long-standing cases.

After he had satisfied himself that growth by cell multiplication is stimulated by sulfhydril, Dr. Hammett undertook to find out why such growth is checked under natural conditions. Since oxidation processes go on rapidly in growing tissues, it seemed natural to infer that the sulfhydril compounds were oxidized, and that as they added more and more oxygen to themselves they lost the power to stimulate cell division. He applied various partly-oxidized sulfur compounds to growing plant and animal tissues, as he had originally applied sulfhydril compounds, and found that the oxidized substances did cause a slowing down of growth. His successful experiments on the mouse tumors followed.

THE STUDY OF SOUTH AMERICAN INDIANS

A STUDY of the many Amerind peoples who once possessed the two western continents is necessary if we are to understand the history, economic development or present psychology of the Latin-American nations to the south of us. This was the thesis advanced at the meeting of the American Philosophical Society on April 24, by Dr. A. V. Kidder, of the Carnegie Institution of Washington. We have not realized the importance and value of understanding Indians, he said, because in the development of the United States the original possessors of the land were simply swept aside and did not become a factor of much real significance.

But in the Latin-American countries, where the Indians still form a large proportion of the population, and where even the upper classes often have a considerable amalgam of Indian blood, one can not expect to gain an intelligent knowledge of the land without studying the history of the Indian in all its phases. Progress in the study of man has been slow because of the vastness of the subject, and also because its difficulties have not been frankly faced and cooperative investigations, upon which ultimate success presumably must depend, have seldom been undertaken.

Dr. Kidder pointed to the work of the Carnegie Institution of Washington and associated agencies in Yucatan as an example of success in such a cooperative anthropological and archeological enterprise.

"The chosen field is small," he said, "it is representative, it offers problems of world-wide and age-long significance. Work in Yucatan is to be prosecuted by specialists, but close touch is to be kept between the groups, with a view to the pooling of resources, the formulation of, and the planning of ultimate attacks upon problems which are too large for the present methodologic weapons of any one discipline, but which are of fundamental interest for all disciplines."

THE ECLIPSE OF 1932

AMERICANS who missed the eclipse of the sun in California on April 28 will only have to wait a few years—until the afternoon of August 31, 1932, for another. Then a total eclipse will be visible along a path about a hundred miles wide, crossing northeastern Vermont, all of New Hampshire but the southwestern corner, southwestern Maine, Cape Cod and the northeastern corner of Massachusetts in the vicinity of Gloucester.

This will be much better astronomically than the eclipse of April 28, for it will last more than a minute and a half, instead of the second and a half this month. The path will be wide enough so that astronomers will have no anxiety lest they miss it. Already Dr. Frederick Slocum, of the Van Vleck Observatory of Wesleyan University, has made a study of weather conditions at this time of year, and finds that the interior of Maine, at such places as Hiram, East Baldwin and West Buxton, offers some of the best chances. Probably these towns will be a mecca for the world's astronomers at that time, for the International Astronomical Union will hold its first American meeting immediately afterwards. In fact, the meeting would ordinarily have been held in 1931, but was postponed for a year in order to permit astronomers from foreign lands to combine the eclipse and the meeting.

However, some American astronomers will have a chance to see an eclipse of the sun without waiting for two years. On October 21 of this year a path of totality will cross the south Pacific. A tiny island, Niuafou, in the Tonga group, is the only accessible land on the path. Dr. S. A. Mitchell, of the University of Virginia, a veteran eclipse observer, will head an expedition there under the sponsorship of the U. S. Naval Observatory.

After 1932, the next eclipse seen in the United States is on August 9, 1945, but it will only be visible at sunrise in Montana. Thence it travels northeastward across Canada, where astronomers may observe it. In 1954, on June 30, one begins in Nebraska, and travels to the northeast over Lake Superior, the southern end of Hudson Bay and Labrador. Probably this will be well observed. On March 7, 1970, one crosses central Florida. As this is near the middle of the path, there will probably be a number of astronomers watching it.

May 30, 1984, brings another central eclipse, like the one this month, but the total part of the path is longer and wider. Then the total eclipse will be visible along a path crossing Mexico and the southeastern states, going to sea near Maryland.

On May 10, 1994, an annular eclipse will cross the entire country from California to Maine, though as the moon will not completely conceal the bright solar disc, but will leave a ring of light around it, astronomers will probably not give it much attention. It will, however, be an interesting spectacle. In 2012 another annular

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THE book deals with the theoretical discussion of the laws governing the structure of atomic spectra. These laws are described throughout with reference to the vector model of the atom, which is closely related to the orbital model of the old quantum theory, for it has been found that this visualizable model forms the best basis for a simple and clear interpretation of spectra. The use of the model is justified by the detailed treatment of the hydrogen atom, throughout the book extensive application is made of the results of the quantum mechanics to correct the approximate formulas obtained from the model, bringing out clearly the importance of the new theories.

Outstanding features of the book are a chapter containing a complete and unified treatment of the structure of X-ray spectra and a chapter on hyperfine structure. The latter gives for the first time a detailed discussion of this very new field of spectroscopy, in which spectroscopic data reveal even the intrinsic properties of atomic nuclei. Many details of the treatment given in these chapters as well as in other parts of the book have not before been published.

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eclipse occurs on May 20, visible along a path from California to Texas.

The year 2017 brings one of the best American eclipses in the coming century, for then the path of totality sweeps squarely across the country from California to North Carolina. This occurs on August 21, and the path will probably be dotted with the super telescopes that astronomers of that distant date will enjoy.

Another annular eclipse, on October 14, 2023, visible along a band across southern California, completes the American eclipses of the coming century.

THE RECENT TYPHOON IN THE PHILIPPINES

A TYPHOON such as that which struck 14 towns on the Island of Leyte, of the Philippines, on April 18, destroying the homes of thousands and apparently killing many, according to first meager reports, would do but little damage in the United States.

In fact, typhoons have struck the United States, for the typhoon and the hurricane are exactly the same except in name. An average of five hurricanes a year sweep from their birthplace in the doldrums of the tropical Atlantic toward the southeastern and Gulf States.

From such storms America is protected as the Orient will not be for years, because of the stable character of the buildings in this country. The typhoon reaps a huge harvest of dead among the inhabitants of the frail houseboats which swarm together in floating cities.

Then there are many lines of communication in America by which warnings and news can be sent and relief rushed to the stricken area before disease has a chance to take a foothold. But even if the Far East had all these advantages, the loss of life would be great merely because the population is so dense and there are so many people to strike in any area.

There was evidence of a disturbance between the Island of Guam and the Philippines as early as Monday of last week, according to the U. S. Weather Bureau. But the typhoon was quite unexpected, as few occur at this time of the year. August, September and October bring the majority of these storms in the Orient.

The region west of Guam is a part of the birthplace of most of the typhoons. It is the doldrums of the Pacific, a calm area of hot, humid atmosphere. Here heated air rises through cooler and heavier layers and sets up the initial whirl. The storm then moves off, gathering volume as it goes.

It is an extensive disturbance, often hundreds of miles in diameter, and has a dead area with practically no wind in its center, while beyond velocities as great as 130 miles an hour have been measured. The typhoon center travels about 10 or 15 miles an hour over most of its course. It holds to practically the same course for days, but is hard to predict because it comes from an unfrequented part of the ocean.

A typhoon brought the heaviest one-day rainfall ever recorded. At Baguio, the summer capital of the Philippines, 46 inches fell in 24 hours on July 14–15, 1911.

ITEMS

IF you get stronger radio reception from a station northwest of you it is likely to rain next day. If the reception is weaker than average, it is a sign of fair weather, according to a paper read before the meeting of the American Physical Society by Professor R. C. Colwell, of the University of West Virginia. Listening to station KDKA, Pittsburgh, night after night at his set at Morgantown, West Virginia, Professor Colwell noticed that whenever there was an area of low atmospheric pressure, presaging a storm, between the two cities, the strength of the signals was increased. When a high pressure area moved in, bringing fair weather in its train, the signal strength decreased. If the low pressure area passed to the south of Morgantown, instead of going between the two cities, the signal strength remained unchanged, and so could not be used for weather prognostication.

PURE water, containing no mineral salts in solution, transmits ultra-violet light fairly well. But, according to Dr. Charles D. Hodgman, of the Case School of Applied Science, Cleveland, Ohio, who spoke at the Washington meeting of the American Physical Society, a little dissolved mineral makes a thin layer of water much less transparent to these invisible radiations. He found that a layer less than an inch thick of common lake water, taken from Lake Erie, and containing no more mineral than most city water, stops about a quarter of the longer-wave ultra-violet rays and nearly nine tenths of the short-wave rays.

RIBBED photographic film, such as amateur movie makers use when they take movies in color, was suggested as a means of making still photographs in color by Dr. Herbert E. Ives, physicist of the Bell Telephone Laboratories, speaking before the American Philosophical Society. Dr. Ives pointed out that this was really a revival of an instrument invented by his father, Frederic E. Ives, called the chromolinoscope, in which a separate screen of tiny ridges separated the light from a lens divided into three parts by three different-colored filters. This method was applied for amateur color movies by impressing the ridges on the film itself. Dr. Ives also suggested a means of copying such pictures in color, by photographing them with similar ridged film, but with the ridges running at right angles to those in the negative, thus avoiding troublesome "moire" effects.

BLASTING their way through ledge rock, 115 feet deep at the thickest point, engineers have recently converted the 1,316-foot Ona tunnel on the Chesapeake and Ohio Railway nine miles east of Huntington, W. Va., into an open cut with little interference to the passage of the 75 daily trains. A false wooden tunnel within the concrete one torn down protected traffic from overhead blasting and made this feat possible. As the excavators reached the concrete they tore it away, leaving the frame structure intact. Then, after the cut had been widened to 70 feet at the bottom, trains were routed over a temporary track and the wooden shell was dismantled.

TESTED H L STANDARDS

PURE PROTEINS OF MILK vs. CRUDE CASEIN

THE PURE PROTEINS of milk are so difficult and expensive to prepare, that only too often the crude products are inadvisedly used in researches of importance. One "crude essential element" of the diet may invalidate all other good features of a costly investigation, thereby disqualifying the deduction of the author.

In recent journals such papers have appeared.

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(cf.—Osborne & Harris, Jr. Am. Chem. Soc., 25-IV, 346)

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MENTAL HYGIENE AND PUBLIC HEALTH

"THERE would be just as much sense in sending the case of scarlet fever to a reformatory as in sending a delinquent schoolboy to jail," said Dr. Haven Emerson, professor of public health administration at the College of Physicians and Surgeons in New York City, at the opening meeting of the First International Congress on Mental Hygiene.

"Public health work can no longer be limited to the control of communicable disease, correction of physical defects in children or safeguarding the lives of mothers and children in childbirth. It must also include prevention of mental disease and correction of defects in nervous and emotional control.

"The health officer must begin to ask himself such questions as: Will the psychiatrist get to the mean lazy ne'er-do-well before the policeman does? Will the bully, the fearful child, the miserable man, meet a wise social worker before he is forced into an institution?

"Is it not at least as important that the suicide rate has risen from 4.9 to 19.7 per 100,000 of our people in seventy years as that the diabetes death rate has done about the same? Is there a greater need to report upon a rising death rate from appendicitis or to analyze, publish, teach and if possible prevent the conditions that have brought about a rise in the divorce rate from 26 per 100,000 to 68 per 100,000 in less than fifty years?"

If the Traveler's Aid stations at our city railroad terminals can show the number of runaway children, unwholesome homes, misunderstood wayward children, the too-heavy hand of discipline, they are as important to public health as collecting depots for diphtheria smears and typhoid cultures at our drug stores and hospitals.

It is just as much the province of the doctor of public health to concern himself with occurrence of temper tantrums as with the prevalence of rickets in a community. Perhaps the probabilities of truancy can be estimated on the basis of the records of boys who have motherless homes or breakfastless mornings.

Much improvement in the field of mental health may be hoped for through preventive measures. Only about one tenth of retarded school children owe their difficulties to such causes as heredity, mental disease or epilepsy. Dr. Emerson pointed this out as an encouraging fact when considering the possibilities of prevention. Betterment of social, emotional and material surroundings and in particular of the parental conduct of the child's life prior to school age may result in as great benefits as we have seen among babies from the almost universal use in our cities of safe water and pasteurized milk.

THE TREATMENT OF "PSYCHOPATHS"

"WE must reckon it a definite fact that 50 to 75 per cent. of our beggars, tramps, thieves and so on, show serious psychic abnormalities," according to Professor Karl Birnbaum, of Berlin, who spoke at the congress.

Professor Birnbaum discussed the social significance of those mentally and nervously weak individuals known to science as psychopaths. His studies of these types, how they develop and how they can be aided to adjust themselves to normal every-day standards of life, have made him an international authority on psychopathic personalities. So high is the percentage of mental abnormality in the repeaters lodged in county jails that these supposed prisons are in reality little hospitals for psychopaths.

Unstable individuals who can not get along with their families or employers, or with police regulations, are marked as psychopaths by several signs. They are at war within themselves, lacking psychic harmony. They are weak in resisting. Often, their personalities do not mature at the normal rate, but there is a pathological interruption of development, so that they remain betwixt-and-between, neither adult nor child, longer than most young people. At about the age of thirty, there often comes a "secondary balancing" of their troubled personalities, and they settle down to normal attitudes toward their work and their associates.

These unstable persons need individual treatment adjusted to their own needs, and they should have it at the earliest possible date. Their lives should be so directed for them that society is protected against their instability, and at the same time they should be given aid in finding suitable work and social intercourse. A small group does not respond to such individual aid and these incorrigible natures can only be taken care of through the force of safe confinement.

RECREATION AND AVOCATIONS

A WARNING against intemperance in the use of the radio, which it was suggested would produce mental indigestion comparable to the physical indigestion resulting from intemperate consumption of food, was issued by Dr. R. Sommer, professor of psychiatry at the University of Giessen, chairman of the German Association for Mental Hygiene, at the closing meeting of the congress.

"We must take a stand in regard to the modern invention of the radio, which allows the individual to expose himself to a great number of impressions," Dr. Sommer said. "To be sure there is much exaggeration here, just as in the case of overeating. But if these technical achievements are sensibly used, if people are temperate in listening to music and lectures, and do not, as often occurs, try to take in in a short time an international mixture from all sorts of cities, the radio can also be used in the problems of mental hygiene."

Dr. Sommer spoke on the meaning of recreation and avocation in mental hygiene. In a wide sense, suitable nourishment and sleep must be called recreation, since this term means a rebuilding of exhausted forces, both physical and mental.

Too much food is harmful, rather than beneficial, medical and physiological investigations have shown, and

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Dr. Sommer suggests that too heavy a program of other types of recreation might also be harmful.

Speaking of sports as means of recreation, he said that their value must always be decided for the individual case, and that sports and exercise as recreation for women should be chosen carefully with due regard for the physical make-up of women.

"I have seen often that a well-regulated and intellectually interesting avocation saves people from premature petrification and, psychically, from senility," Dr. Sommer remarked in discussing the advantages of avocations as a form of recreation. "Of course, there are various kinds of preoccupation with one or more of the arts. For me, for example, it is a source of recreation to look at a picture or a statue, considering all its details; for others, the same is perhaps true in the realm of music, or they may find it in reproducing great works by playing the piano. It is no mere chance that a whole list of famous physicians have become known through their avocations—music, literature, etc. This is merely one special example in the general field of recreation after exhausting activity."

CARRIERS OF TUBERCULOSIS

FROM one half to nine tenths of the people in this country are carrying in their bodies the germs of tuberculosis, Dr. Linsly R. Williams, president of the National Tuberculosis Association, declared at the opening, recently, of the annual meeting of the organization which has for over a quarter of a century been fighting the dread "white plague."

"We must consider every person as a possible carrier of tuberculosis," Dr. Williams said. If there were but a few thousand carriers the problem might be solved, he explained. But probably one tenth of that vast portion of the population that carries the germs are what are called "spreaders," meaning that they not only carry the germs but spread them to others.

Dr. Williams outlined the scientific knowledge we now have about the disease, and said that if it could be applied to the population, tuberculosis might be eradicated.

"But we can not handle and control human beings as we do a test-tube or a guinea-pig. The human being insists on escaping from his cage, even though he be incarcerated for life. In some measure we can isolate those individuals who are a constant menace to society. It is even possible to isolate persons who constitute a definite danger because at the moment they harbor bacteria which are dangerous to others, but when it comes to the chronic carrier of tuberculosis, the case is difficult."

A plea for directing efforts at diagnosis of tuberculosis to an earlier period of life was made, based on the theory that the majority of people in this country have been infected with tuberculosis by the age of 15 and more than 90 per cent. by the age of 21. Dr. Williams urged that the entire population be watched by annual X-ray examinations so that the persons who have definite signs of disease can be put under proper treatment at an earlier age.

OCEANOGRAPHIC INVESTIGATIONS OF THE "CARNEGIE"

THERE are three different kinds of water in the ocean, scientists of the Carnegie Institution of Washington, one of whom belonged to the staff of the ill-fated, non-magnetic ship, *Carnegie*, reported on May 1 to the American Geophysical Union meeting in Washington.

Results of some of the deep sea determinations of the *Carnegie*, which was destroyed with the loss of Captain Ault in Western Samoa last November, were commented on by H. W. Graham, biologist and chemist, in a paper presented by Dr. J. A. Fleming, as follows: "These samples show that the waters may be divided into three general layers. An upper layer where an active plant and animal life is maintained, a middle layer in which a decomposition of organic remains is taking place, and a lower layer which represents water which has been conducted from polar regions. The upper layer shows high values of dissolved oxygen but low values of phosphates, silicates and hydrogen-ion concentration. The middle layer is low in oxygen but is high in phosphates and silicates and is relatively less alkaline. The lower layer tends toward conditions at the surface with again higher values of dissolved oxygen and lower of phosphates, silicates and hydrogen-ion concentration."

How a shotgun and a stop-watch were used to determine the distance to the bottom of the ocean when the sonic depth-finding apparatus broke was told by Floyd M. Soule, of the ship's staff, and C. C. Ennis. The depth-finding apparatus, which was borrowed from the U. S. Navy, is an electrical device for accurately measuring the time it takes a sound to travel to the bottom of the ocean and return. Knowing the speed of sound in water, the scientists could then quickly calculate the depth of the ocean.

"A steel breech just long enough to hold a 16-gauge shotgun shell was screwed into one end of a length of brass pipe. The pipe acted as a holder and also as a guide for a heavy steel firing pin which was dropped into the upper and open end of the pipe, the shell end being held a foot or two below the surface. The hydrophones were used to pick up the echo and a stop-watch used to measure the elapsed time. Soundings were taken in this manner twice a day. These were only roughly approximate because of the inaccuracy of the stop-watch measurement and because of the uncertainty of the velocity of a sound set up by an explosion. However, it was a case of half a loaf being better than no bread, and the device materially assisted in the routine occupation of oceanographic stations."

Sound sent to the ocean's floor behaved strangely and in unaccountable ways. Sometimes the reflection would be loud from depths and weak from shallows. Again loud echoes and faint echoes would come from places where all known conditions were similar and even where bottom samples were very much alike. The echoes from five-mile soundings were stronger than those often heard from less than one mile.

In water sound travels nearly a mile every second, more than four times as fast as it does in air. On sev-

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eral occasions signals were picked up after traveling twenty-five miles back and forth between the bottom of the ocean and the surface, and once they had gone nearly fifty miles, having been reflected fifteen times when last heard.

A NATIONAL HYDRAULIC LABORATORY

A GREAT national hydraulic laboratory, the first duty of which will be to discover scientific principles essential to the construction of Boulder Dam, will be built at the U. S. Bureau of Standards, according to the bill recently passed by the Congress.

Boulder Dam will be nearly twice as high as any dam now in existence and will contain more than three times the concrete in the immense Muscle Shoals Dam and power house. Engineers do not know every detail of the building of such a huge dam so unlike anything man has ever created. Experiments must be conducted and ideas tried in the laboratory first to be sure they work before extensive construction is begun.

The engineers must find, for example, how to design spillways which, if ever used to their capacity, will have to absorb about seven times the power in the falls at Niagara. These spillways will be like huge funnels with rims 150 feet and shafts 50 feet in diameter down which water will fall more than 500 feet.

Problems of flood control on the Mississippi River are now being studied by the Water Experiment Station of the Mississippi River Commission at Vicksburg. Functions of this laboratory and the one for Washington will not overlap, it has been explained, and there will be more than work enough for both.

The Bureau of Standards laboratory will become a national research institution in a field which has been only slightly investigated in the United States and in which private concerns are not prompted to pioneer because much of the large hydraulic construction is carried on by the government. It will cost $350,000.

Such federal agencies as the Geological Survey, Federal Power Commission, War Department Corps of Engineers, Bureau of Public Roads and Reclamation Service will bring their problems to it. Among the subjects of investigation are irrigation and drainage, construction of dams, silting of streams, design of spillways, prevention of scour and resistance of bridge piers to water flow.

ITEMS

A RELAXATION in the rigor of the quarantine regulations against the Mediterranean fruit fly has been announced by the U. S. Department of Agriculture. The new ruling will permit the passage through quarantine lines of certain vegetables, notably peppers, that have been sprayed with mixtures containing copper compounds as precautions against other plant troubles. It has been found that copper salts are poisonous to the fruit fly, and in thus protecting the vegetables against other enemies the growers have prevented their infestation by the fly. The regulations restricting the movements of fruits from the fly area, however, still stand.

EIGHTEEN skeletons of prehistoric man have been found to date this season by the Beloit College-Logan Museum Expedition into Algeria, according to a check-up of the results by Dr. Alonzo Pond, leader. In addition to the human remains, several skulls of prehistoric gazelles with both horns attached have been found, together with innumerable scattered bones of other animal species.

MEASUREMENTS of the heat given off when a powder is wetted by or immersed in a liquid, important when pigments are mixed with oils to make paint, were reported to the American Chemical Society by Dr. William D. Harkins and R. Dahlstrom, of the University of Chicago. Speaking before the paint and varnish section, they told of a new method of making such measurements in which the particles in the powder had a clean surface. Because the action takes place in the outer layer of molecules in the particles, the presence of very small amounts of impurities has a great effect on the wetting of the powders.

THE speed of ultra-sound waves, vibrating 400,000 times a second, twenty times as fast as the shrillest audible sound, in various solutions of chemicals was described at Atlanta by Drs. E. B. Freyer, J. C. Hubbard and D. H. Andrews, of the Johns Hopkins University. Speaking before the section on physical and inorganic chemistry, they told of their work with the sonic interferometer. From such measurements can be determined the compressibility, or "squeezability" of the liquid. The chemicals tested were solutions of chlorides, bromides and iodides of potassium and sodium, including common salt.

REMOVING oxygen from a chemical compound by shooting atoms of oxygen at it is the paradoxical result achieved in an experiment by Professor W. H. Rodebush and W. A. Nichols, Jr., in the laboratory of physical chemistry at the University of Illinois. The effect was produced with the chemical compound known as molybdenum trioxide. Removal of oxygen is called a "reducing action" by chemists. Atoms of hydrogen have a very great attraction for atoms of oxygen and pull them out of compounds to form molecules of water. Hitherto the effect has not been obtainable with oxygen atoms, and this is the first time that oxygen itself has been made to serve as a reducing agent. The experimenters say that with the molybdenum trioxide the effects of hydrogen and oxygen are identical.

A CAT'S ability to detect high tones is about as great as that of human beings, Dr. Ernest G. Wever, of Princeton University, told New York members of the American Psychological Association at their recent meeting. Dr. Wever has settled this point by experiments with cats along the same line as the conditioned reflex experiments devised by the Russian physiologist, I. Pavlov. Three of the cats tested heard tones as high as 10,000 to 20,000 cycles per second. The human voice at its highest ranges to no more than 5,000 cycles.

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SCIENCE NEWS

Science Service, Washington, D. C.

PHARMACEUTICAL RESEARCH

NEVER in the history of the world have the possibilities of adding to the list of valuable drugs been so great as at the present time, according to a statement made by Dr. Reid Hunt, professor of pharmacology at the Harvard Medical School, and president of the United States Pharmacopoeial Convention, at the opening session of the convention's decennial meeting in Washington.

We may yet get more drugs from the plant and animal kingdoms. There is no limit to the number that the chemist and the pharmacologist may synthesize in their laboratories. But even more important is the possibility that new and important uses may be found for drugs which we already have.

Some of the saddest pages in the history of mankind have written on them the failure of physicians to see the possibilities for treating disease with well-known chemicals. Ether was known to doctors and chemists for nearly 300 years before it was used as an anesthetic, Dr. Hunt pointed out. Another drug, amyl nitrate, a few drops of which relieve the frightful agony of one form of heart disease, was well known to chemists for twenty-three years before it was used to treat this condition. The same delayed application was repeated in the case of other anesthetics and many other drugs. They were well known chemically for years before any one tried them in the treatment of disease and for the relief of pain. "To-day," said Dr. Hunt, "relief may be obtained anywhere in the world for a few cents, which fifty years ago was beyond the reach of any potentate or Croesus."

Research is needed to investigate the medical possibilities of the 258,000 organic compounds which chemists have already carefully described chemically and physically. New compounds are being added to the list at the rate of about twenty a day. Dr. Hunt stated that America's facilities for studying the medical applications of these new compounds are very inadequate compared with research activity in Germany and other European countries.

THE STANDARDIZATION OF ERGOT

A NEW chemical method of standardizing a drug widely used in childbirth may be the means of saving countless lives of mothers and babies. The drug is ergot. The new method of standardizing it, which is a chemical, colorimetric method, was devised by Dr. M. I. Smith, of the U. S. Hygienic Laboratory, who reported it at the meeting of the American Pharmaceutical Association.

The method requires much less experience, less time, less trouble, and is more accurate than the physiological method which is given as the standard by the present U. S. Pharmacopoeia, which is the legal standard for drugs and medicines.

Dr. Smith believes that a biological method of standardizing ergot, developed by Professor Clark, of the University of Edinburgh, is better than that given in the U. S. Pharmacopoeia. His new chemical method agrees well with this English one.

Ergot is a complex drug containing many chemical substances, among them alkaloids. It is the alkaloids which are important, but not all of them are physiologically active. Chemical methods of determining the alkaloids were described many years ago, but Dr. Smith's method is the first to determine quantitatively the physiologically active alkaloids of ergot.

Some 40 samples of fluid extract of ergot were examined by his method, of which ten were commercial extracts ready for the market. These varied in potency as much as 500 per cent., the strongest being five times as strong as the weakest.

This difference may be very serious when the drug is given to a mother in childbirth. The dose given is for ergot of a standard strength, but the physician has no way of telling whether the ergot is standard or not and must rely on the label on the container.

Manufacturers can not come up to the U. S. Pharmacopoeia standards chiefly because they have not a good method of standardizing the drug. Dr. Smith believes that his method gives them the means of producing uniformly standard ergot.

MICROSCOPIC MOVIES

MOVIES showing microscopic cells 3,000 times larger than they actually are and bringing out slight variations in shade which are unnoticed by the naked eye looking through a microscope have been taken at the Rockefeller Institute of New York, Dr. Heinz Rosenberger reported recently to the Society of Motion Picture Engineers.

Dr. Rosenberger said that during the past few years scientists have been able to increase more than ten times the magnifying power to which movies can be applied. Among the interesting discoveries made by these pictures is an undulating membrane surrounding white blood cells which is much larger than the cells themselves.

This membrane was invisible to the naked eye making examinations through ordinary microscopes, but it was brought out by the photo emulsion which often reveals differences in shades too fine to be detected by the eye. Dr. Rosenberger pointed out that the usual stains used to outline cells can not be employed with the camera. When subject to the great light necessary in taking the pictures the stains cause the cells to act abnormally and to die fast.

"Difficulties of high magnification photography increase rapidly by arithmetical progression," Dr. Rosenberger said. "Suppose we are looking at the moon through a telescope. When it is a low-powered telescope the moon will move slowly across the field of vision, due to the rotation of the earth. With medium-power telescopes the moon will apparently move very much faster across the field, while with high-powered telescopes one can hardly follow its rotation."

The same applies to microscopes, it was explained. As

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LOCUSTS IN EASTERN EUROPE

THE locust plague that has appeared clear across northern Africa, from Egypt to Gibraltar, and has extended into the Near East and the Balkan countries, is a distinct menace to the great wheat areas of eastern Europe but is not likely to make trouble in the countries with which American travelers are most familiar.

This is the opinion of entomologists of the U. S. Department of Agriculture, as given to *Science Service*. Locusts are more or less chronic in what might be called the drier cereal areas all over the world. The wheat and barley lands of northern Africa, Palestine, Asia Minor, Mesopotamia and all the Black Sea basin both in Europe and in Asia have to contend with them every year. But some years are much worse than others, and the present outbreak may indicate 1930 as one of the bad ones.

The presence of swarms of the insects in Roumania is the first hint of big trouble, for Roumania is a major wheat country. If the locusts spread farther and reach Ukraine and other parts of Russia, which are comparable with the western United States and Canada as wheat regions, the results might be disastrous. There have been no indications as yet of locusts in Russia, but the real crisis will come a little later, when warm weather sets in.

The old-world locust is a large, long-winged grasshopper that flies in swarms so vast as to darken the sun. When such a swarm settles on a field or orchard it often wipes out every trace of green leaf and stem in fifteen minutes or less. The devastation they can cause, and the terror they bring, have never been told more graphically than by the writer of the Book of Exodus, in Chapter 10, Verses 12 to 20. "There remained not any green thing in the trees, or in the herbs of the fields" has been written many times since, and of many other lands besides Egypt.

The locusts of Europe, Asia and northern Africa are all members of one species, usually called the Moroccan locust. There is a short-winged locust, but it is considered by most entomologists to be simply a form or life-phase of the long-winged locust. During part of its life the swarm will travel by hopping or very short flight along the ground. In this stage it can be fought by poisoned baits, by trenching and by various other mechanical and chemical means. But when the insects have grown their long wings and taken to the air, no method so far devised can avail to stop them.

LOCATION OF EARTHQUAKES BY SEISMOGRAPHS

CABLE dispatches from Teheran, telling belatedly of a serious earthquake that killed 2,000 persons and caused wide-spread damage in the vicinity of Urumiya (Urumiah) Lake in northern Persia, were anticipated by *Science Service's* announcement of the earthquake. The location of this disaster was determined a few hours after its occurrence through analysis of the telegraphed records of seismographs located in the United States, the Philippines, China and Canada.

The earthquake occurred Tuesday, May 6, at 5:34 P. M., Eastern Standard Time, and sent its vibrations to all parts of the world. Within a few hours seismological observatories cooperating with *Science Service* had telegraphed, radioed or cabled their records. Experts of the U. S. Coast and Geodetic Survey utilized the data in locating the epicenter or place about which the earthquake centered.

Two days before interrupted communication brought direct cable news, on Wednesday morning, *Science Service* announced to newspapers: "A violent earthquake occurred in northern Persia late yesterday. It is probable that many were killed and much damage was done."

Information from the region of the earthquake shows that the Persian disturbance is probably as serious as the Burma shock of May 5 about which more information has come to America.

According to the United Press dispatch the shock was most severe in an area west of the southern end of the Caspian Sea, some 400 miles northwestward of Teheran. The inhabitants are mostly Armenians.

When the earth shakes severely, vibrations from the center of motion travel to all parts of the earth. They go in two principal ways, one through the center of the earth, the other along the surface. It is this fact that makes possible the determination of the quake's distance. The internal wave travels faster than the surface wave, and so is felt by distant seismograph stations first.

The seismograph, the instrument with which earthquakes are detected, consists essentially of a pendulum arranged to swing on the slightest motion of the earth under it. Greatly amplified, the motion is recorded on a moving strip of paper as a wavy line. Every minute a clock also makes a mark on the paper so that the exact time of a record can be obtained.

When an earthquake is not occurring, the line is straight. Then, as the first wave of a quake reaches the instrument, it starts to wave. A few minutes later, unless the quake is very close, another series of waves appear. These are the result of the vibration that traveled along the earth's surface.

Seismologists have studied many earthquakes and as a result they have compiled tables from which the distance of a quake from a seismograph can be determined from the difference in time of arrival of the two waves.

The record of a single station can only locate the earthquake on a circle at a certain distance from the station. Sometimes this circle may cross a region where earthquakes are frequent and then it would seem probable that the quake occurred there. However, when reports are received from several stations, circles can be swung on a globe around each of them. Where they intersect is the exact location of the quake.

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By such a procedure *Science Service,* with the cooperation of the U. S. Coast and Geodetic Survey and Jesuit Seismological Association and telegraphic reports from some 30 seismological stations throughout the world, locates many earthquakes.

SMITHSONIAN EXPEDITIONS TO ALASKA

Two scientific expeditions are setting out from the Smithsonian Institution for Alaska, to seek clues to the origin of the Eskimos and to pursue the quest for the mysterious first American immigrants.

Dr. Aleš Hrdlička, who has measured and studied thousands of Eskimos, both living and prehistoric types, is *en route* to the Kuskokwin River in southwestern Alaska. He hopes to fill in missing links in his chain of evidence as to what the relation may have been between the Eskimos and other American tribes, and how they link with the Asiatic tribes.

The second expedition about to depart is conducted by Henry B. Collins, Jr., archeologist at the Smithsonian, accompanied by James A. Ford, of the Mississippi Department of Archives and History. This expedition is heading for St. Lawrence Island in the Bering Strait, where it will explore four ancient Eskimo villages a thousand years old or older.

"Until very recently it was not realized that the prehistoric Eskimos of Alaska were artistic and ambitious craft workers, far surpassing any modern Eskimos in their attainments," Mr. Collins said in outlining his plans. "St. Lawrence Island was a strategic center of this rare, lost culture of the Arctic. Two previous years of digging have revealed three stages of Eskimo life, showing that the artistic taste and the energy of the oldest known Eskimos eventually dwindled and degenerated.

"This year we hope to dig through the frozen soil into unprobed levels and so find out what led up to the Eskimo golden age."

The possibility of finding traces of far more ancient men, that is, some of the original immigrants who found their way from Asia into America, is another hope that spurs on the efforts of excavators in this Bering Strait region. Even if the earliest men entered America in inter-glacial times, when there was a land bridge across to Alaska, all the clues of their passage might not be lost, for the islands and shores remaining above water might still hold some of their tools or their bones, Mr. Collins believes.

ITEMS

THE 69-inch mirror of the new Perkins Observatory telescope has reached the polishing stage at Pittsburgh and is now having its surface given its final shape. It is the largest piece of optical glass made in the United States and when completed will be placed in service at Ohio Wesleyan University, Delaware. It will then be the third largest reflecting telescope in the world.

UNTIL its tranquillity was broken by the severe earthquakes of May 5 and 6 in Burma and Persia, the crust of the earth had been singularly free from severe disturbances since the Aleutian Islands world-shaking shock of December 17 of last year. This period of nearly six months of comparative freedom from earthquakes is unequalled in the recent annals of seismology. When earthquake experts gathered in Washington for meetings a few days ago it was a topic of conversation. A local shock in Imperial Valley, California, the first week in March, and a larger earthquake centered in the Banda Sea, between the islands of Borneo and New Guinea, on March 26, were the only earthquakes on record in the quiet period.

A RESEARCH radio station isolated in the middle of a 200-acre farm is provided for in a bill introduced by Representative R. N. Elliott, of Indiana, which has passed the House. It is necessary for experimental purposes to get as far as possible from buildings and electrical disturbances. The new radio laboratory would be located near the District of Columbia and run by the U. S. Bureau of Standards. It would be established at a cost of $147,000.

PROOF that there is a possibility of two plants being produced from a single seed has been obtained at the botanical laboratory of the University of Southern California, where Mrs. Tema Shults Clare, a teaching fellow, obtained in two instances pairs of twin seedlings sprouting from Torrey pine seeds, and one pair of similar twins from the seed of a pinon pine. Further examination of seeds showed that this condition is possible in at least a small percentage of pine seeds. One pinion pine seed contained the beginning of six little plants, four of which had developed to a point indicating that they might have grown if the seed had been planted. Mrs. Clare's work is supported by earlier investigators who, although they did not sprout twin seedlings, at least observed potential twins in seeds which they dissected. This habit of twinning from single seeds is peculiar to the gymnosperms, the great division of the seed plants to which pines and other evergreens belong. The higher seed plants, the producers of showy flowers, apparently do not have this possibility.

SUNFLOWER plants that have a warm place in the sun have nearly four times as many calories per plant as plants grown in the shade with other conditions exactly the same. This is one of the interesting facts about energy content of plants discovered by Dr. Frances L. Long, of the Coastal Laboratory of the Carnegie Institution of Washington at Carmel, California, in investigations that utilized the oxygen bomb calorimeter, an apparatus most frequently used to determine the energy value of fuel. Dr. Long used the heat of combustion as determined in the calorimeter rather than chemical analysis and subsequent calculations of caloric values. The energy in seeds was also determined. Castor bean seeds contain 2,975 calories, or 20 times as much as oat seeds. The calories in seeds represent all of the sun energy stored during the previous year and not used by the plant in its growth. They are the energy passed on as food for the sustenance of the new seedling of the next year.

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SCIENCE NEWS

Science Service, Washington, D. C.

WIND TUNNEL AND SEAPLANE BASIN AT LANGLEY FIELD

Two new and unique research aids to better airplanes are under construction at the Langley Memorial Aeronautical Laboratory of the National Advisory Committee for Aeronautics.

One will be the largest wind tunnel in the world, in which a whole airplane can be tested. The other will be the world's largest testing basin, a covered body of water nearly half a mile long, 25 feet wide and 12 feet deep.

The governmental aeronautical research laboratory already has the largest wind tunnel in the world, the propeller research tunnel, with a testing diameter of 20 feet. In a wind tunnel the stream of air flows past an airplane part, or test specimen, that is held stationary, and this is exactly the same as though an airplane were moving through still air. The engineers can therefore tell just what happens to an airplane in the air without the risk and inconvenience of actual flying. Precise scales and instruments attached to the airplane under test give data that allow better design and financial savings by airplane designers. Airplane speed has been increased 10 to 12 miles per hour by the National Advisory Committee for Aeronautics cowling developed in the 20-foot tunnel.

The wind tunnel now under construction will have a rectangular mouth 30 by 60 feet. An airplane can be taken from the flying field to the wind tunnel and put under test without any change whatever. A large building covering an area 434 by 222 feet will house the new giant tunnel. Two large propellers, each 35½ feet in diameter and powered by 4,000 horse-power electric motors, will furnish the air stream that will be equivalent to the rush of an airplane through the air in actual flight.

The seaplane testing basin, also under construction, is 2,060 feet long and will probably be in operation late this year. In it flying boats will be given test runs at speeds up to 60 miles an hour. Both Navy and commercial users of planes that land on water are eager to have adequate test information as to how floats and other water landing gear can best be built. At present floats and pontoons on seaplanes and amphibians are built more or less by rule of thumb because of lack of knowledge of the way they carry their loads. The testing basin is expected to furnish information that will allow better, more efficient and cheaper construction.

HYDRAULIC LABORATORY OF THE BUREAU OF STANDARDS

PRESIDENT HOOVER has signed the bill authorizing the construction of a National Hydraulic Laboratory at the U. S. Bureau of Standards at a cost of $350,000.

Funds will probably be made available by Congress for use on July 1 so the laboratory can be completed and its work begun during the coming year. Plans being prepared under the direction of H. N. Eaton, of the Bureau of Standards, are expected to be completed next fall.

Enough projects to keep the laboratory busy for a long time are ready to be submitted by the U. S. Reclamation Bureau, the Bureau of Public Roads and the Geological Survey. The laboratory will doubtless be completed in time to conduct some tests for Boulder Dam and the chief of engineers of the U. S. Army may request experiments in connection with Mississippi flood control. It is intended primarily for fundamental studies in hydraulics.

The erection of the laboratory comes as an indirect result of the efforts of a well-known hydraulic engineer, John R. Freeman, to make research in river hydraulics in this country comparable with that in Europe. Surprised at advances abroad in the solution of river problems by model tests and anxious to bring this information to America and establish these methods in this country, Mr. Freeman provided scholarships to enable young American hydraulic engineers to study in Europe. These returning students and a book by Mr. Freeman describing European laboratories and methods have largely caused the adoption of more modern practices and the establishing of up-to-date laboratories in this country.

PLANT GROWTH STUDIED WITH THE INTERFEROMETER

THE growth of plants can be seen with a new form of interferometer devised by Professor K. W. Meissner, of Frankfort, Germany.

The instrument is a modification of the interferometer invented by Professor A. A. Michelson, of the University of Chicago, and used by him in his epoch-making experiments with light.

The interferometer is literally a device which permits the measurement of very tiny distances, far beyond the reach of the most powerful microscopes, by means of light-waves. A beam of light from a lamp is separated into two rays at a lightly silvered glass plate, and each of the two beams is reflected from a mirror, the two being reflected back to the plate, where they reunite and fall into an observing telescope. When two such beams are properly superposed, they are capable of "interfering," and we have the curious situation of light added to light giving darkness at certain points, for what one sees in the telescope is not a uniformly illuminated field, but a series of alternating bright and dark bands, or "interference fringes."

If, now, one of the mirrors be slightly displaced, the fringe pattern moves to one side, and the distance it moves is a measure of the motion of the mirror. So sensitive is the method that it is readily possible to measure a displacement of the mirror of a millionth of an inch.

Professor Meissner mounted the entire instrument vertically, thus bringing a whole new range of measurable phenomena within its scope. The movable mirror

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is carried by one arm of a trip-scales arrangement which permits a vertical motion of the mirror. The scales are very nearly balanced, and the mirror arm is allowed to rest very lightly on the stem of the plant whose rate of growth is to be measured. As the plant grows, it pushes up the movable mirror, and the interference bands in the telescope are seen to wander across the field. Simply counting the number which pass a given mark in a certain time gives the rate of growth, which is of the order of one hundred thousandth of an inch per second for most plants, so that a single line would move more than its own width in a second.

Ether fumes are wafted over the plant, almost immediately the growth ceases; a mercury lamp, rich in ultraviolet rays, is switched on, and the rate of growth increases many fold. It is such investigations as these which Professor Laibach is carrying out with the new instrument.

Professor Meissner, in demonstrating his device before the Congress of Physicists and Mathematicians in Prague, pointed out among other uses of the instrument the measurement of crystal growth and the analysis of musical tones and vibrations.

VITAMIN A IN CORN

S. M. HAUGE and J. F. Trost, of the Purdue University Agricultural Experiment Station, have found that vitamin A is present in corn which has kernels that are yellow all the way through. The fact that yellow corn contains more vitamin A than white was observed by Dr. H. Steenbock, of the University of Wisconsin, but not until the work of the Purdue investigators was it known whether the yellowness associated with the vitamin was present in the outer coat or in some other part of the seed. Now it appears that it is the yellowness of the starch storage tissue called endosperm, and not the yellowness of the outer coat of the grain, that indicates the presence of vitamin A.

This discovery adds one more requisite to the list of qualities expected in a successful new variety of corn. Heretofore yield and resistance to disease have been the main factors considered. Now the color of the endosperm must be taken into account, because it is of course desirable to have as many nutritive items as possible in the same food.

Professors Hauge and Trost have found that the vitamin A content of corn is inherited in a simple definite way, just as yellow color is. This will prove of great assistance to the plant breeders in the production of new varieties for they will know when and when not to expect the vitamin in making certain crosses.

Vitamin A is the one which prevents the eye disease known as xerophthalmia and is also necessary for growth. It is of vital importance in the nutrition of all the higher animals including man. It occurs rather abundantly in green leaves, in certain roots, in butter and in egg yolk. In edible plant tissue it seems to be usually associated with yellow color. Thus yellow carrots contain more than white, yellow turnips more than white, and so on as far as tests have been made.

THE NEW COMET

THE new comet recently discovered by the German observers Schwassmann and Wachmann may become visible to the naked eye on June 1, and will certainly be discernible with the aid of a small telescope or a pair of good field glasses. The last few nights of May and the first few nights of June will be great times for the army of amateur telescope fans, who make and use their own reflecting telescopes. With instruments of this type, the new comet can easily be seen, if one knows where to find it.

The orbit of the new comet has been calculated by F. L. Whipple and Phyllis Hayford, of the Students' Observatory of the University of California, under the direction of Professor R. T. Crawford. Their preliminary results indicate that the comet will reach its maximum brightness on June 1, when it will be only eight million miles away. This is very close for another celestial body to approach the earth, much closer than any comet has been for many years.

The comet will be between sixth and seventh magnitude in brightness on the night of June 1. For most persons with ordinarily good eyes, sixth magnitude stars are the faintest that can be seen; so that the celestial visitor may just barely cross the borderline into naked-eye visibility.

It is a small comet, without any tail. At that, however, it is the nearest thing we have had to a visible comet for many years. Although the solar system is visited by anywhere from two or three to a dozen comets each year, most of them are too small or stay too far away to be seen except with the big telescopes of astronomical observatories. The last really good look the lay world has had at comets was in 1910, when two big comets, one of them the returning Halley's comet and the other known simply as the "Comet of 1910," blazed in the sky at the same time. Both of these were huge affairs, with magnificent tails sweeping across a large fraction of the heavens. The present visitor is much less pretentious.

The astronomical position of the Schwassmann-Wachmann comet on June 1, corresponding to earthly latitude and longitude, will be approximately 21 hours right ascension and plus ten degrees declination. This is a spot a little to the southeast of the constellation of the Dolphin, a small group of bright stars that lies almost directly south of Cygnus, or the Northern Cross, well down toward the horizon. At nine in the evening the Dolphin is low in the east; it reaches its highest point in the sky about three in the morning.

If the new comet becomes visible to the naked eye it will appear simply as a very faint star. With the aid of a telescope or strong field glasses it will be distinguishable as a somewhat fuzzy nucleus of light, contrasting with the stars, that show up as sharp little pin-pricks.

On June 13 the comet will reach perihelion, or its nearest approach to the sun. At that time it will be about ninety million miles from the sun, or approximately the distance of the earth's own orbit. After the middle of

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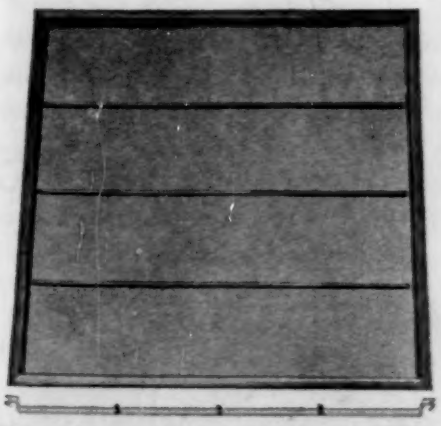

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June it will rapidly recede and dwindle in size, until even the astronomers will see it no more.

TOOLS OF THE OLD STONE AGE IN CHINA

OLD STONE AGE implements have been found in the eastern part of Shensi province along the upper courses of the Yellow River, proving that man existed there during the ice age, according to a report made before the annual meeting of the Geological Society of China held in Peking.

The discovery was announced by Père Teilhard de Chardin, the Jesuit priest who, with Père Licent, found traces of a similar culture on the borders of the Ordos Desert in 1923. Père Teilhard is president of the Geological Society of France and ranks high among the world's paleontologists.

Among the specimens exhibited to the meeting were some typical Paleolithic scratchers and a boulder of very hard quartzite which appeared to have been broken by heavy blows and probably was used for smashing up other pieces of stone into convenient sizes. Similar implements were found in many places along the northern section of the Yellow River, mostly in gravel terraces, and also along the line of the Great Wall.

"Here we have proof that in Pleistocene times man was living not only on the edge of small lakes in the Ordos Desert but also along this part of the Yellow River," Père Teilhard declared. "This culture is exactly the same as the one of which we found traces in 1923 and might be compared with the Mousterian culture associated with Neanderthal man in Europe."

Careful search may reveal a still more extended stone culture of that time in the fertile valley of the Yellow River. The fact that the implements were found in the base of the loess is interpreted to mean that the land surface in which these early people dwelt was shortly afterwards overwhelmed by terrific dust storms which deposited millions of tons of windblown débris from the Gobi Desert.

From then on, it is thought, all sign of human culture vanished from the stage, man having been driven out and not returning till his reappearance with a fully developed polished stone culture corresponding more or less to the Neolithic culture of the post-glacial time in Europe.

ITEMS

THE plant patents bill, which if enacted will make it possible for plant breeders to obtain patent protection on new varieties that can be propagated by cuttings, grafts and similar means, has been passed by the House of Representatives and is now on the Senate Calendar awaiting action. It may be passed by the Senate, also, before adjournment. If it is left unenacted in the jam of closing business, it will remain on the Senate Calendar and can be acted on early during the next session of Congress.

INSULIN and liver extract, the one a cure for diabetes and the other for pernicious anemia, may be placed in the next edition of the U. S. Pharmacopoeia, standard for drugs and chemicals. These two are among the new drugs, discovered since the last revision in 1920, t considered by the committee on revision which elected by the U. S. Pharmacopoeial Convention rec in session. This convention is held once in ten years the committee it selects decides on the contents o next Pharmacopoeia. Other drugs which doctors pharmacists have asked to have included are ephed which brings relief to asthma sufferers; irradiated gosterol and viosterol, potent sources of vitamin D w prevents rickets; diphtheria toxin-antitoxin for tes which determines whether a child or adult will get theria if exposed to it; ethylene, a new anesthetic, two new germicides, mercurochrome and hexylreso

REPORTS of icebergs on the transatlantic ship lane been received by the U. S. Navy's Hydrographic O from the Coast Guard Cutter *Mojave*. Although th early for ice to appear in the path of shipping, with *Mojave* patrolling the threatened area and reporting locations of the bergs the situation is not consid dangerous and a change of the path to a more south route will not be recommended, the Hydrographic O says. More bergs have been observed north of the Atlantic turning point, the only place at which ve change the direction of their 2,000-mile voyage bet Europe and America. This ice may move down on lane or be swept aside and melted by changing currents and winds. The positions of the bergs ca estimated only a few days in advance.

THE different sugars of germ cells are probably a the most important chemical substances concerned the vital processes of the cells, Professor Treat B. J son, of Yale University, reported to the National berculosis Association, meeting at Memphis. In the laboratories, tuberculosis germs by the pound have analyzed chemically and found to contain among things poisonous sugars. The sugars of the bac cells exist in very complex forms. The existence of complex, highly poisonous sugars appears to be chara istic of germ cells in general, and are not necess characteristic of the tuberculosis germs alone. W considering the question of immunity to diseases, proteins of the cells have been given chief atte Professor Johnson suggested that the sugar of the must now be taken into consideration as well.

COTTON plants are strangled to death by hard, dry in a new disease of cotton which has been discovere J. J. Taubenhaus, W. N. Ezekiel and H. E. Rea, of Agricultural Experimental Station, College Sta Texas. "Root strangulation," as the disease has named, occurs only in flat, poorly-drained, heavy soils, which are compacted by continuous rain or ir tion. The affected plants wilt and die suddenly. W the dead plants are pulled they seem to have no r However, a careful investigation shows that the p do have a well-developed root system, but that the soil literally strangles the plants to death by cons ing the roots and preventing the passage of moi from the soil to the top of the plant.

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SCIENCE NEWS

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STUDY OF LOCUSTS IN PALESTINE

THE migratory locust of Africa, which is now causing wide-spread damage throughout northern Africa and the Near East, is being attacked as a major scientific problem by entomologists of the Hebrew University at Jerusalem. Recent studies by Drs. F. S. Bodenheimer, G. Fraenkel, K. Reich and N. Segal have contributed new facts which will eventually be of use in conquering this age-old bringer of desolation and famine.

Although the locust is about the oldest of recorded insect pests, strangely enough very little positive knowledge has been gathered as yet regarding its biology, habits and primary breeding places. One of the first things developed by the investigators at the university has been definite evidence that the locust is not strictly an insect of the desert, as has usually been supposed. There are strong indications that the primary breeding ground of the insects that make trouble in Egypt, the Sinai region, Transjordania and Palestine is in the moderately moist borderlands of the desert, and that a bad locust year is almost always preceded by a decidedly rainy winter, giving the ground where the eggs are laid plenty of water in its upper layer. This hypothesis is supported by evidence gathered by earlier workers in the Sudan and elsewhere.

Studies both in laboratory and field indicate that the eggs are not formed in the body of the female locust until spring. After they are laid in the ground the young insects inside the shells require from two to four weeks before hatching. While they are passing through their five larval stages, growing larger each time they shed their skins, they begin their migratory march. In six or eight weeks they have become full grown winged adults, and their migrations become the vast flights that darken the sun and strip fields and orchards bare. Their adult life seems to last about ten months, completing the year's cycle.

Locusts are decidedly insects of clear sky and hot sun. They avoid the ground and the stones upon it during the chilly hours of night, roosting on the vegetation, especially on shrubs. When the first signs of dawn appear they hop down to earth, and creep about in small clumps until the first direct sunlight reaches them. Then they stop and sun themselves for a time, standing broadside on, to get the full benefit of the early rays.

As the day warms up, the horde begins its march. It keeps relentlessly ahead, climbing over all natural obstacles and not diverting from its set course even when an easier route presents itself. If the weather is very hot, the insects stop for a siesta at midday, this time turning their bodies so as to expose as little surface as possible to the sun, or taking advantage of all chance patches of shade. On resuming march in the afternoon they feed voraciously, cleaning everything bare where they stop for lunch. Late in the afternoon, when the temperature falls, they call a halt, again sunning themselves, seeking dark stones for warmth whenever possible. Then they climb the shrubbery for the night.

These reactions seem to be governed by temperature rather than by light, for it has been found that when the weather is very warm they will march all night. Locusts are decidedly warm-weather creatures. At all stages in their lives they like high temperatures, thriving best when the mercury stands so high in the tube that human beings are distinctly uncomfortable.

COTTON PREDICTIONS

FICKLE weather and the boll-weevil have been made to tell as early as the first of September almost exactly how much cotton will be harvested in United States during the following fall months.

Just how these predictions can be made, based on the weather reports from hundreds of stations throughout the cotton belt, was made public for the first time by J. B. Kincer, chief of the division of agricultural meteorology of the U. S. Weather Bureau, at the recent meeting of the American Meteorological Society.

The method which Mr. Kincer and his associates, W. A. Mattice and Miss G. B. Diehl, have worked out during the past two years will give cotton growers, buyers and investors accurate information on production far in advance of the harvest and should enable them to sell and buy more profitably. Calculations have been made of estimated and actual production since 1909 with an accuracy of approximately ninety-seven per cent.

For the bumper crop year of 1926 the actual production was almost exactly the same as the predicted. In 1921, the year of smallest yield, an error of seven per cent., the largest of the 20-year period, was made. For 1928 the prediction was only three per cent. less than the actual production.

To make the calculations, Mr. Kincer used weather information such as amount of rainfall, number of rainy days, relative humidity, amount of sunshine, and average, highest and lowest temperatures. Weevil damage is estimated from the weather of the preceding summer, which determines the number of insects that hibernate during the winter; from the severity of the winter, because many might be killed by the cold, and from growing season weather, as dry weather keeps the weevil in check and damp weather greatly increases his family.

From this information a weevil index is worked out by mathematical relations to be combined with the weather-yield relation for the final result. The predictions can be made for each state as well as for the entire cotton belt.

This is the first study of cotton prediction for the cotton belt as a whole made on combined weather and weevil effects. Details of the method are to be published in technical journals.

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A MADAGASCAR RUBBER PLANT

A RUBBER plant that yields strips of pure rubber from cuts in its rind, and is able to grow in the driest desert, is now thriving in Washington. Cuttings brought back from Madagascar by Dr. Charles F. Swingle, of the U. S. Department of Agriculture, are being propagated as rapidly as possible, so that they may be transplanted out of doors in the Southwest and in other warm parts of the country, to test their rubber-yielding qualities under American conditions.

The plant was famous a little over a generation ago, when it caused a veritable "rubber rush" in Madagascar. The rubber export from the island jumped from 50,000 pounds to over a million pounds a year. Then, due to crude methods recklessly employed in gathering, the wild plants were practically wiped out, and not until Dr. Swingle went to Madagascar in company with the French botanist, Professor Henri Humbert, of the University of Algiers, were they rediscovered.

The plant is a large bush or small tree belonging to the euphorbia family, of which poinsettia, castor bean and the Para rubber tree are well-known representatives. It is known to botanists as *Euphorbia intisy*. The second name is one of the native Malagash words used to designate both the plant and the rubber taken from it.

One of the most remarkable features of the plant is the thoroughness of its adaptation to desert life. Real desert plants are usually organized to offer stubborn resistance to desperate environments, and the intisy is one of the best-organized desert plants known. Its leafless, switchlike stems, coated with wax, yield very little water to the demands of the arid air, and the gum that forms in every wound effectively stops bleeding of sap. Finally, intisy has one of the most efficient of water reservoirs, stowed safely underground on its roots. Dr. Swingle states that no other plant has anything quite like it.

Each root is thickened in a series of sausage-like swellings, and practically the whole of the enlargement consists of water. The water is stored in swollen-up cells with which each "sausage" is filled. It is good water, too—the very slight "planty" taste did not deter Dr. Swingle and his party from slaking their thirst on these roots, in preference to the very poor drinking water usually obtainable at the desert water holes. He has given the structures the special name "hydriarhizas," which means "water-jug-roots."

AN INTERNATIONAL WILDERNESS AREA

A GREAT stand of virgin forest, dotted throughout with hundreds of lakes, will be preserved as a great recreational area, if the Shipstead-Nolan bill now pending is passed by Congress.

This wildwood region, abounding with fish, game, natural camping sites and beautiful scenery, is partly in northern Minnesota and partly in adjoining Canada. It includes in its area the present Superior National Forest, but takes in much more territory.

The interior lakes are in many instances connected by channels containing rapids and waterfalls. A hardened camper could make his way with a canoe and a pack. But it will be no place for the average tourist to go in his automobile, even though one can reach the heart of it in twenty-four hours after leaving Chicago. The railroad does not go into the area and the automobile highway touches only on its fringe.

Legislation to preserve this region for posterity is necessary because of power development which certain industrial interests would bring about, particularly on the boundary waters between Minnesota and Canada.

Certain timber will be cut in the area under the direction of the governments concerned, but water levels of the lakes must not be changed, except temporarily for logging purposes.

The Canadian area is part of the Province of Ontario and is known as the Quetico Provincial Park. At present there is more wild game on the Canadian side than on the American.

THE CALMETTE SERUM

THE Calmette-Guérin method of antituberculosis inoculation of new-born infants, which has recently resulted in a number of deaths in a German baby asylum, is not used in the United States. American physicians in general have not advocated the method as have Continental doctors. Those American physicians who have favored it have advised a period of trial on animals before using it for human infants.

The method was developed by Drs. A. Calmette and C. Guérin, of the Pasteur Institute, Paris. A kind of half-starved strain of tuberculosis germs from cattle is injected into the infants during the first few hours or days of life. The germs are supposed to have lost their disease-producing power, but to have retained the faculty of producing immunity or resistance to the disease. The originators of the method claim that it gives the babies protection against tuberculosis to which they may later be exposed.

The method is claimed to be particularly suited for the protection of children, born of tuberculous parents, who would be continuously exposed to the disease during the first year of life, before they have a chance to acquire any immunity or resistance to it.

The method has been used at various European centers and even in Indo-China. At Luebeck, Germany, the deaths of 17 infants following the inoculations are being investigated by health authorities. Well over 50,000 infants born into tuberculous households have been inoculated in France. The mortality among these children is very much less than among other French babies who do not receive the inoculations and who are exposed to the disease in their homes.

Professor C.-E. A. Winslow, of the Yale School of Public Health, recently advised that the method be given a thorough trial of animal experimentation in this country. Dr. M. H. Soule, of the hygienic laboratory of the University of Michigan, was even more enthusiastic about the method after visiting Dr. Calmette's clinic in Paris. Other American scientists, among them Dr. S. A. Petroff, of the Trudeau Sanitorium, Trudeau, N. Y., and

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Dr. Ralph Mellon, of the Western Pennsylvania Hospital, Pittsburgh, have warned against the method.

THE RADIO BEACON

Two vibrating white reeds on the instrument boards of New York-Cleveland mail planes will soon paint an air path visible in fog, rain and snow over 250 miles of the worst flying terrain in the United States, it is announced by Clarence M. Young, assistant secretary of commerce for aeronautics.

This visual radio range beacon to be installed during the next few weeks will supplement the aural type radio range beacon that has been in use at Bellefonte, Pennsylvania, in the Appalachian mountains for more than eighteen months, and if it proves satisfactory will probably replace the aural beacon and be extended to other parts of the country. Its installation is necessitating expensive changes in transmitting equipment and the addition of a reed box to the planes. The apparatus is a joint development of the U. S. Bureau of Standards and the aeronautics branch of the Department of Commerce.

The aviator tells whether he is on the right path by watching two white reeds vibrate. If the reed on the left vibrates most, he has veered off to the left of his course. If the amplitude of the right-hand reed is greatest, the plane is too far to the right. When both vibrate alike the plane is on its true course.

The aural beacon system now in use gives the same information by coded signals picked up in the head phones. Great concentration is required of the pilot and he must wear the phones practically all the time.

Neither beacon system makes unnecessary the searchlights which are installed at 10-mile intervals. When the weather is open the lights can be followed, but when the aviator must go for miles through fog, rain or snow which completely hide the ground and lights, he has to rely on the beacon to keep him on his course. A recent test flight from Detroit to Washington through bad visibility was made almost entirely by beacon signals and not by maps.

The path of the beacon will bring the pilot close enough to the landing field for him to see the ground lights and make a descent by sight. No effort is to be made at the present time to put in practice "blind" landing as accomplished by Lieutenant James H. Doolittle for the Guggenheim Fund.

ITEMS

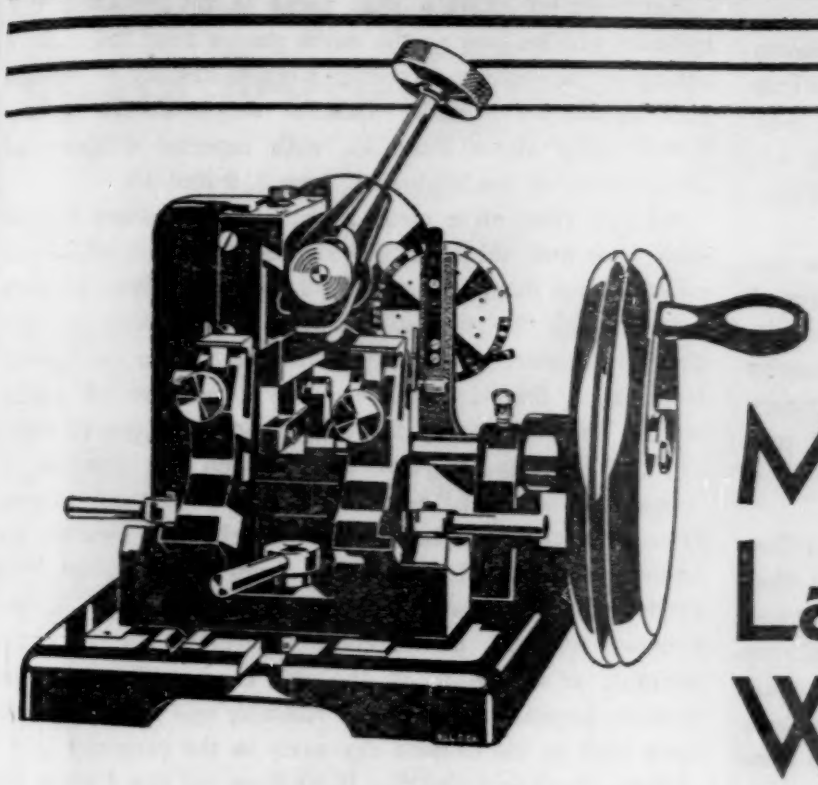
THE release of eight persons who have been cured of leprosy at the National Leprosarium at Carville, La., has been announced by the U. S. Public Health Service. The apparent cure of these eight patients, in addition to some sixty others released within the last eight years, represents further proof of the efficacy of the treatment with chaulmoogra oil as it is now carried out at the National Leprosarium, which is under the direction of the service.

ETHYL gasoline has been given a good bill of health in Britain, provided its handling is attended by ordinary precautions. The questions raised regarding its safety have been investigated by a departmental committee on ethyl petrol, which has just issued its final report. The committee worked along lines somewhat similar to those followed in the earlier investigations in the United States, taking into consideration the results of the American experiments. The aspects of the tetra ethyl lead problem on the committee's agenda included danger from lead in street fumes and dust, spillage on the skin, and evaporation and combustion fumes in closed garages. Danger of lead poisoning in the latter case was considered to be considerably less than the well-recognized menace of carbon monoxide.

CARSICKNESS, a kind of seasickness which some people suffer from riding on street cars, does not result from the rider's looking out of the window, as has been popularly believed, Dr. James E. Lebensohn, of Northwestern University, reported to the American Physiological Society. The illness is caused by the disturbance of the labyrinth of the ear due to the jarring of the car. In his experiments subjects in the laboratory were able to follow a moving object which caused their eyes to move back and forth for hours without suffering any nausea. But when the up and down motions and slight jars of a moving car were reproduced in the laboratory, the carsickness resulted. The same condition was produced when the labyrinth of the ear was stimulated by electricity, so that the fluid in the semicircular canals of the ear was continually disturbed.

YEASTS have been makers of alcohol for many millions of years. Their cells have been found in rocks older than the Coal Age and infinitely older than the times of the dinosaurs by Professor Johannes Grüsz, of Berlin. With them in many cases were tiny bubbles of carbon dioxide gas, the same stuff that makes the "bead" on home brew. Professor Grüsz found the yeasts as an incident in his search for the oldest fungi in the world; yeasts are a specialized form of fungi. The other fungi which he found, in rocks of Devonian age, were parasites on the primitive plant life of those days. They infested their stems and fruiting bodies, breaking down the cells and feeding on the tissues, as parasitic fungi do to farmers' crops and foresters' trees to-day.

A PARALLEL for the old American tale about owls and rattlesnakes living in the same burrow has been found in New Zealand. Only the rattlesnake-owl story is now doubted by naturalists, while the new find is attested to as genuine by a correspondent in *Nature*. On eight or ten groups of islets near East Cape, North Island, N. Z., there are numerous tuataras, a strange lizard native to these islands. The same islets are inhabited by colonies of petrels, who nest in burrows in the ground. In many cases the burrows of the petrels are shared by tuataras during the nesting season, while in winter, after old and young petrels have departed for the north, the lizards hibernate in the burrows. Both petrels and lizards sleep during the day, departing at dusk to seek food. While a lizard may occasionally devour a solitary chick of the petrel, in general he lets it alone.



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SCIENCE NEWS

Science Service, Washington, D. C.

THE GORILLA FILM "INGAGI"

A PROTEST against the film "Ingagi," widely shown throughout the country, was made by the American Society of Mammalogists at its recent meeting in New York City, according to an announcement made by Dr. William K. Gregory, of the American Museum of Natural History.

The formal resolution adopted read: "That in accordance with the facts brought out in the discussion of the film 'Ingagi,' which has been viewed by many of our members, the American Society of Mammalogists hereby expresses its utter disapproval of this film, which grossly misrepresents the natural history of Africa, while pretending to be a truthful record of a scientific expedition."

A statement issued on behalf of the society further stated: "The American public should understand that certain animals shown in the film have never been found in the wild state in Africa. Also that a man made up as a gorilla is represented as carrying off a native woman. In response to many protests and letters, certain members of the American Society of Mammalogists who have done field work in Africa have viewed the film and are unanimous in deploring its numerous fictitious features which are misleadingly mingled with genuine natural history records."

The American Society of Mammalogists is the leading organization of specialists on mammals, of which great group of animals man and the higher apes are the most advanced members. The resolution on "Ingagi" was sponsored by Dr. Gregory, Harold J. Coolidge, Jr., assistant curator of mammals of the Museum of Comparative Zoology at Harvard University; H. E. Anthony, curator of mammals of the American Museum of Natural History, and James L. Clark, in charge of taxidermy and animal restoration at the American Museum of Natural History.

The British Embassy stated in response to an inquiry that there is no Englishman by the name of Sir Hubert Winstead, who is credited in the film "Ingagi" with leading the African expedition claimed to be described in the film. Information from official British sources was requested after scientists had condemned the motion picture on the grounds of inaccuracy and misrepresentation of scientific facts.

METEOR DISPLAY PREDICTED FOR EARLY IN JUNE

COMET 1930d, as the astronomers call the new visitor to the heavens discovered by Drs. Schwassmann and Wachmann, is expected to cause a meteoric display about June 9 radiating from the region of the sky slightly west of the constellation of Hercules and above the Northern Crown. This is the prediction of the Japanese astronomer, Professor Issei Yamamoto, of Kyoto, Japan, and American astronomers are urging all interested to keep a lookout for an unusual number of meteors.

Astronomers explain that there is no certainty that meteors will be seen as the earth passes near the comet's orbit, but a chance of seeing a good display is not one that should be missed. Careful watch should be continued until about June 11, with especial diligence of observation on the nights of June 8, 9 and 10.

At any time on a clear night shooting stars may be seen here and there in the sky at intervals of several minutes, but at special times of the year when the earth cuts through the path of meteoric swarms they are particularly numerous and appear to come from one general location in the sky. There are a number of annual meteor swarms met by the earth, most famous of which are the Leonids on November 14 and the Perseids on August 12, so named because the meteors appear to come from the constellations after which the swarms are named. The display expected from comet 1930d is an extra heavenly meteoric exhibition and that is why astronomers are particularly interested in it. The radiant, or the point in the sky from which the June meteors appear to diverge or radiate, will be nearly overhead high in the eastern sky early in the evening.

Both Professor Charles P. Olivier, of the Flower Observatory, University of Pennsylvania, and Dr. Harlow Shapley, director of the Harvard College Observatory, urge amateurs to record the numbers of meteors seen each hour during the time of their observations. Those who are experienced with the use of star charts should record the path of each bright meteor among the stars. The duration of flight should be timed or estimated. In the event that bright meteors appear in large numbers an effort should be made to photograph the meteor tracks.

Reports of observations should be sent to Professor Olivier, the University of Pennsylvania, who will utilize them in connection with other reports received from members of the American Meteor Society which has as its special objective the observation of meteors.

METAL WALLS ON SKYSCRAPER

THE coming of the steel and glass skyscraper of the future, its height limited by economic considerations rather than by structural difficulties, is being hastened by the use of sheet metal largely to replace brick and stone in the new Empire State Building now being erected in New York City.

A silvery chrome-nickel-steel alloy in angular sections one twentieth of an inch thick will form a large part of the walls of the building. The metal was first developed for gun linings and is unrusting, non-tarnishing and unaffected by weather.

Such thin walls are likely to be used for buildings of the future. Some architects feel stone and brick walls for skyscrapers are not in keeping with steel structurally and are merely a heritage. The metal is said to save floor space, cost less and weigh less, give more light and result in better health for the occupants. Glass would be used to such an extent that partitions and great portions of outside walls would be made of it.

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Each class is limited to a maximum of 75 students, men and women being admitted on the same terms. Applications may be sent any time during the academic year but not later than June 15th.

If vacancies occur, students from other institutions desiring advanced standing may be admitted to the second or third year provided they fulfill the requirements and present exceptional qualifications.

INSTRUCTION

The academic year begins the Tuesday nearest October 1, and closes the second Tuesday in June. The course of instruction occupies four years and especial emphasis is laid upon practical work in the laboratories, in the wards of the Hospital and in the dispensary.

TUITION

The charge for tuition for 1930–31 will be $600 per annum, payable in two installments. There are no extra fees except for certain expensive supplies, and laboratory breakage.

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Medical candidates must have completed three years of college work with special requirements in chemistry, physics and biology. The entering class will not exceed 50, men and women being admitted on equal terms.

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This tallest skyscraper in the world being erected on the site of the old Waldorf-Astoria hotel at 34th Street and Fifth Avenue will be the nearest approach to the structural limit of 2,000 feet as determined by computations of the American Institute of Steel Construction. Its 85 floors will rise 1,043 feet high, and the building itself will be surmounted by a 200-foot observation platform or mooring mast for airships.

Eiffel Tower rises 1,000 feet, the City Bank and Farmers Trust Co. will be 925 feet and the Bank of Manhattan 838 feet tall. The Chrysler Building soars 808 feet and the Woolworth Building 792 feet.

The enormous weight of elevator cables, the inability of the human ear to withstand rapid pressure changes in an elevator going faster than 1,500 feet per minute, and the large floor area needed for elevator shafts make it impracticable to exceed the approximate 2,000-foot structural height limit.

The economic height depends upon the cost of land, the Steel Institute says. Its studies show that where land value is $200 per square foot a 63-story building brings greatest returns. Where the value is $400 per square foot a 75-story building was found to be most economical.

FOOD FOR DOGS

"If you want your dog to reach a ripe old age, say twenty years, do not feed him the choice cuts of meat; feed him the internal organs, the parts generally thrown away," says Dr. William Lentz, director of the small animal hospital of the University of Pennsylvania. Checking up on research on longevity in dogs, Dr. Lentz has found that among a number of dogs which reached the age of twenty years or more, the great majority had access to the waste material cast out by butchers and abattoirs, this waste consisting of the softer internal organs, and not the firm muscular portions of the meat.

The dog, being carnivorous when left to himself, follows the instincts of his wild brothers, since observation has shown that beasts of prey do not devour the muscular portions of the animals which they bring down, but rather rip the carcass open and eat the inner organs. Dr. Lentz points out that man has sought to adapt the dog's diet to his own, much to the detriment of the dog. It appears that carnivorous animals derive certain benefits from the softer diet, and from certain qualities contained in the glandular organs.

Dr. Herbert Fox, director of the Pathological Laboratory of the Philadelphia Zoological Society, and author of an outstanding work on diseases of wild animals in captivity, has found that the diet of muscular meat, ordinarily fed to lions and other carnivora in captivity, is not nearly so beneficial to them as a diet of softer meat, more nearly approximating the lion's choice in his wild state. Study is being given this subject by Dr. Fox, who is also director of the Pepper Pathological Institute of the University of Pennsylvania.

ITEMS

THE plant patents bill, which makes it possible for plant breeders to protect their new hybrids as though they were mechanical or chemical inventions, has been passed by both houses of Congress and signed by President Hoover, making it law. The terms of the act extend protection only to plants that are propagated by cuttings, grafts and similar asexual methods; not to new varieties of plants propagated by seeds. A further exception excludes plants that are propagated asexually by tubers, of which class potatoes are the most notable example.

THE color of the new planet Pluto, as Planet X has been christened by its discoverers at Lowell Observatory, is totally unlike that of the other outer planets, but resembles the inner ones, Roger Lowell Putnam, trustee of the Lowell Observatory and nephew of the late Professor Percival Lowell, founder of the observatory, has announced to *Science Service*. Mars at the immense distance of Pluto would be no brighter than the new planet. If it is assumed that Pluto reflects the same proportion of the sun's light as the Moon or the innermost planet Mercury, then computations show that Pluto would be larger than the planet Mars which itself is not much smaller than the earth. Only premature publication of an unauthorized story caused the Lowell Observatory authorities to announce their naming of the new planet before communicating with the American Astronomical Society or the Royal Astronomical Society. "It is too soon to draw definite conclusions on the new planet," Mr. Putnam said, "but the fact remains it was discovered substantially in the place predicted by Professor Lowell and its discovery was wholly due to the work started by him."

THE curiosity metal, indium, only about a pound of which has been isolated from its ores, is produced 99.9 per cent. pure by electrolysis. Although it is very rare and what little there is of it brings for experimental purposes about six times as much as platinum, it is hoped that a use will be found for its peculiar properties. It melts at a much lower temperature than tin and is very soft and ductile. Electrolysis separates it from the residue of such ores as iron, aluminum, titanium and silicon, where it is found in small quantities, L. R. Westbrook, of Cleveland, told the American Electrochemical Society at its recent meeting.

THE possibility of mosquitoes giving a disease to other mosquitoes, as they give it to man, has been demonstrated by Major Joe H. St. John and Major James Stevens Simmons, both of the U. S. Army Medical Corps, and Captain Francois H. K. Reynolds, of the Veterinary Corps, working at the Army medical department research board, Philippine Bureau of Science at Manila. Mosquitoes were allowed to feed through guinea-pig skin on the macerated bodies of other mosquitoes which had been infected with the virus of dengue fever. To prove that the second group of mosquitoes had actually picked up the virus, two American soldiers allowed themselves to be bitten by them. They both had typical attacks of the disease.

TESTED H L STANDARDS

PURE PROTEINS OF MILK VS. CRUDE CASEIN

THE PURE PROTEINS of milk are so difficult and expensive to prepare, that only too often the crude products are inadvisedly used in researches of importance. One "crude essential element" of the diet may invalidate all other good features of a costly investigation, thereby disqualifying the deduction of the author.

In recent journals such papers have appeared.

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(cf.—Osborne & Harris, Jr. Am. Chem. Soc., 25-IV, 346)

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SCIENCE NEWS

Science Service, Washington, D. C.

THE CAUSE OF PERNICIOUS ANEMIA

A HITHERTO unknown substance found in the secretions of normal human stomachs, but conspicuously absent from the stomach contents of those suffering from pernicious anemia, may be the key to the medical riddle of the cause of pernicious anemia. Through researches of Drs. William B. Castle, Wilmot C. Townsend and Clark W. Heath, of the Thorndike Memorial Laboratory, Boston City Hospital, it is now known that by an interaction of certain proteins contained in beef muscle and a new substance secreted by the normal stomach this peculiar anemia may be promptly alleviated.

From the standpoint of the anemia sufferer, the disease came under medical control four years ago when Dr. George R. Minot and Dr. William P. Murphy, of the Harvard Medical School, showed that the eating of liver in large quantities allowed the formation of red blood cells by the person with pernicious anemia. Thousands were benefited by this discovery which was followed by a collaboration with Dr. Edwin J. Cohn, of the department of physical chemistry, of the Harvard Medical School, with the result that now small daily doses of liver extract supply the necessary principle which in the early days of the treatment could only be obtained through the consumption of more liver than pleased the palate of the average patient.

One incidental result was that beef liver, once mere cat food, became a high-priced meat since normal red-blooded people who really did not need it thought it would benefit them. Recently Dr. Cohn has been able to prepare experimental fractions of liver which have been successfully used for intravenous injection, the effect of a few tenths of a gram of this material equaling that of many grams of liver.

Not content with producing a virtual cure for the disease, science has pushed onward to determine the nature of the substance that prevents this type of anemia and the reason for the development of the disease. Dr. Castle and his associates found that beef muscle acted upon by normal human stomach juice formed a curative substance. In a recent report to the American Society for Clinical Investigation, Dr. Castle discusses the meaning and possibilities of this new work.

The known constituents of normal human stomach secretions are hydrochloric acid and the ferments, pepsin and rennin. Although all these are conspicuously absent from the stomach contents of pernicious anemia sufferers, Dr. Castle proved by experiments that no one of these can react with beef muscle to produce a curative substance. An unidentified substance appears then to be responsible for these results.

Dr. Castle called the new substance, shown to occur in the normal stomach, "the essential factor of the normal gastric juice," and observed that none of the existing tests for stomach function would detect its presence specifically.

When the new substance is given to the patient with beef muscle in a solution that is neither acid nor alkaline, an effect is produced which promptly benefits pernicious anemia exactly as does liver.

Interesting experiments that may lead to a test for the potency of liver extracts have been made by Dr. Janet M. Vaughan, of England, who has been working at the Thorndike Memorial Laboratory with Dr. Gulli Lindh-Muller and Dr. George R. Minot, of the Harvard Medical School.

A suggestive resemblance to the characteristic condition of the bone marrow in pernicious anemia is found in healthy grain-fed pigeons. This condition in man is changed when the anemia is relieved by feeding liver or potent liver extract. If the condition can also be changed in pigeons by feeding the liver and liver extracts, this would be a method of testing the anemia-relieving power of the extract, it was thought.

Dr. Vaughan's preliminary studies indicated that this might be possible, but the results were not as yet consistent enough to allow final conclusions to be drawn as to the value of such experiments as a test for the potency of liver extracts.

IMMUNIZATION OF NEW-BORN CALVES

THE control of bovine tuberculosis by immediate isolation of new-born calves from infected mothers is the latest victory of the Rockefeller Institute scientists, a victory equivalent to many million dollars of agricultural relief, it appears from a recent report of work done by Drs. Theobald Smith and Ralph R. Little, at the institute's department of animal pathology at Princeton, N. J.

Calves born from tuberculous cows are at birth usually free from the disease. A large percentage of them soon acquire it, however, from contact with infected mothers. Attempts to prevent the spread of tuberculosis to the second generation in an infected herd by immediately separating the new-born calves from the diseased mothers have not been successful heretofore.

In spite of the most careful hygienic care, practically all the calves thus isolated developed gastro-intestinal disease, joint disease, or blood-poisoning. Fully four fifths of them died within the first few days.

Bacteriological examination of these calves has shown that death is usually not due to the common contagious diseases, but to invasion of the living tissues with the ordinary colon bacillus, dung bacillus or other presumably harmless environmental micro-organisms. Evidently the calf at birth is unprepared to resist invasion by ordinary harmless bacteria, micro-organisms causing practically no disturbance in adult cows.

It has been found, however, that calves thus isolated will remain free from such infections if they are allowed one natural feeding before separation from a diseased mother. In this first feeding they do not obtain the

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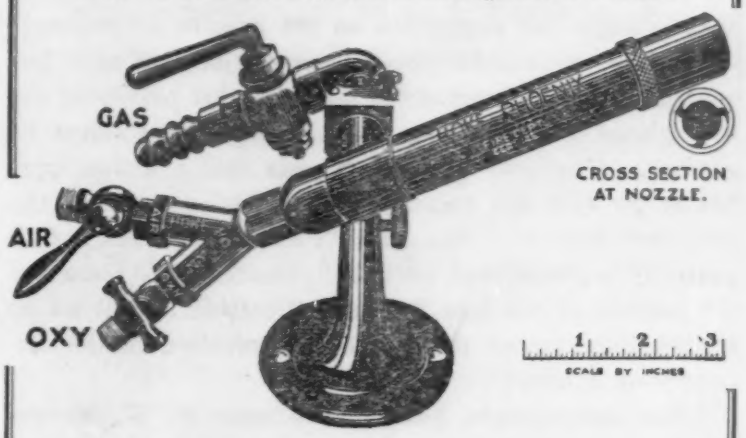

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usual milk, but a specially secreted pre-milk, or colostrum. One colostral feeding is usually sufficient to immunize a new-born calf against the usual non-pathogenic environmental bacteria. Practically all calves thus fed may be successfully raised by artificial feeding.

Veterinarians have concluded from this that there is present in the pre-milk or colostrum some highly efficient natural antidote, specially designed to overcome the birth-handicap. The nature of this colostral antidote has been the subject of intensive research. Now the Rockefeller Institute scientists have found that the normal colostral antidote is identical with, or at least similar to, the normal biological antiseptic in adult cow's blood. Calves may be protected from the usual post-natal infections by one or more initial feedings with adult cow serum. They lost but one calf out of ten after such a preliminary serum meal.

Dr. Smith, who with his associate, Dr. Little, has just made this important contribution to the control of bovine tuberculosis, has likewise to his credit the discovery of the cause of the disease. He was the first to distinguish the bacillus from that causing the disease in human beings. He has been called the first American bacteriologist, and he was responsible for much of the development of the U. S. Bureau of Animal Industry.

PLUTO

THE new planet, Pluto, known as Planet X before its christening by its discoverers at Flagstaff, Arizona, has a juvenile godmother in the person of an eleven-year-old girl of Oxford, England, Miss Venetia Burney. Shortly after the discovery of the new planet by Lowell Observatory, Professor H. H. Turner, the Oxford astronomer, cabled to Professor V. M. Slipher, director, Miss Burney's suggestion that the planet be named Pluto and in the official announcement of the naming Professor Slipher acknowledges the suggestion as the first to be received.

Minerva was another popular suggestion, but as it has long been used for one of the asteroids this prevented the new planet from bearing the name of the goddess of wisdom. Professor Slipher suggests that a fitting symbol to go with the name will be a device made of the two first letters of the name Pluto capitalized, an L partially superimposed on a P. Incidentally, these are the initials of the late Professor Percival Lowell whose studies inaugurated the search that resulted in the discovery of Pluto.

Other astronomers, notably Professor E. W. Brown, of Yale University, in a recent communication to the National Academy of Sciences, have concluded that Professor Lowell's computations of some twenty years ago did not precisely predict the location of Pluto. Professor Slipher answers this criticism indirectly when he writes in a Lowell Observatory Circular that Pluto "appears to be a trans-Neptunian, non-cometary, non-asteroidal body that fits substantially Lowell's predicted longitude, inclination and distance for his Planet X. Lowell considered his predicted data as only approximate, and a one to one correspondence between forecast and find would not be expected by those familiar with the problem. As he himself said in his Trans-Neptunian Planet Memoir: 'Analytics thought to promise the precision of a rifle and finds it must rely upon the promiscuity of a shot gun.' This remarkable trans-Neptunian planetary body has been found as a direct result of Lowell's work, planning and convictions and there appears present justification for referring to it as his Planet X."

THE PHOTOELECTRIC CELL AS A COLOROSCOPE

A NEW use for the photoelectric cell has been found in which the "electric eye" again proves its superiority to the human eye for comparing colors. Textiles of slightly varying shades are now classified by the photoelectric cell more expertly than can be done by manual operatives.

This cell is also the heart of television, it picks cigars of choicest color, and warns when the exhaust smoke in Holland vehicular tunnel under the Hudson River becomes dangerous. Its new application was publicly demonstrated for the first time recently before the New York Electrical Society by the inventors, Dr. H. H. Sheldon and Dr. W. A. Schneider, physicists of New York University.

Dr. Sheldon explained that two cells are used which create a balanced circuit and hold a deflecting needle at zero when both receive the same amount of light. But when the color of the article under one cell is different from that of the article under the other, different amounts of light are reflected to the cells, different currents pass through them and the needle becomes unbalanced and swings away from zero. The needle will vary even when the shades look exactly alike to the human eye.

Error may be introduced by the effects of weave and sheen. Weave effect is overcome by rotation, which melts the pattern into one solid mass of color. Sheen is counteracted by the use of a spherical photometer in which light is reflected from the cloth in all directions so that a concentration of light at any one point is eliminated.

THE CRICKET'S CHIRP

THE ordinary little black cricket can play a full-tone slur in a fiftieth of a second, and that on a pair of notes that a master-violinist can reach only by sliding his finger down on the E-string. And he repeats the feat four times at every stroke of his bow.

Some of the musical secrets of these insect virtuosi have been discovered by Dr. Frank E. Lutz and W. R. Hicks, of the American Museum of Natural History. They assisted at the production of the first "talkie," or more accurately the first "chirpie," of a performing cricket that has ever been made. Afterwards they made a study, with a microscope measuring device, of the alternating shadows and clear bands on the edge of the movietone film that record and reproduce the sounds.

They found out some things, by sight, that the human ear is too sluggish to hear as sound when a cricket chirps. They learned that the insect does not slide the tiny file near the edge of his wing clear across the other wing

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edge at one stroke to produce a chirp. Each chirp, as recorded on the film, separates itself into about four subdivisions, which Dr. Lutz calls "pulses," with imperceptible pauses in between. Each "pulse" lasts on the average a fiftieth of a second, and each pause somewhat less than that. But the human ear, because of its innate sluggishness, perceives the whole performance as a single sound.

A closer examination of a single "pulse" shows that it starts at the high pitch of fifth "D" above middle "C" of the piano keyboard. It rises momentarily a little higher, then slurs downward approximately a whole tone. And all in about a fiftieth of a second.

BY SUBMARINE TO THE NORTH POLE

ASSURANCE that the first submarine expedition to the North Pole will become a reality next summer is seen in the recent action of the U. S. Shipping Board requesting the transfer of the submarine *O–12* from the Navy Department to the Shipping Board to be chartered for use by the Polar expedition which will be headed by Sir Hubert Wilkins.

The Navy Department has previously announced that should this request be made it would recommend to President Hoover that the transfer be made. No objection is anticipated at the White House.

The submarine to be used, the *O–12*, has been on the de-commission list of the Navy for four years and is now in the back channel of the Philadelphia Navy Yard. It is to be chartered at one dollar a year to Lake and Danenhower, Inc., of Bridgeport, Connecticut, and will be remodeled to adapt it to Arctic exploration. Captain Sloan Danenhower, president of Lake and Danenhower, Inc., and a former naval reserve officer, will captain the vessel.

A trolley to indicate open water, powerful searchlights, forward and upward observation glasses, saws and drills for cutting through the ice and an inverted mast to which nets will be attached for collecting specimens of ocean life are among the ingenious devices which Sir Hubert is planning to install in the submarine. The vessel should be able to run for 125 miles without having to come to the surface for charging its batteries.

But Sir Hubert is certain that during the summer months of July and August he will find open places possibly as close together as every five or ten miles. He says that his experience of 15,000 miles of Arctic flying and 5,000 miles of walking over the ice has shown him that there are many patches of water in the Arctic even in winter.

The trip will be made across the Pole from Spitsbergen to Alaska, and will cover an area about which there is least scientific knowledge. The submarine offers greater possibilities for scientific observation in this region than any other means of transportation, according to Dr. Harald U. Sverdrup, of Norway, who has been asked to direct the scientific work of the expedition.

This work will include analysis of ocean water at all depths, study of ocean currents, collection of plant and animal life, collection of bottom samples, measurement of gravity, magnetic observations and sonic depth sounding.

ITEMS

AN earthquake shook the bottom of the Pacific a short distance off the northwestern corner of the United States on Saturday, May 31, beginning at 5:21.4 A. M., Eastern Standard Time, and lasting for about two hours. Using data supplied through *Science Service* by the Canadian seismological station at Victoria and the Alaskan station at Sitka, scientists of the U. S. Coast and Geodetic Survey located the point of its greatest activity at 46 degrees north latitude and 132 degrees west longitude, about 400 miles southwest of Victoria.

A NEW comet has been discovered in the southern heavens by a veteran amateur comet discoverer, David Lamont Forbes, of Rondebesch, South Africa, according to information received by the International Bureau of Astronomic Telegrams at Copenhagen. It is of ninth magnitude, too faint to be seen by the unaided eye, and is not far from the bright star Fomalhaut in the constellation of Piscis Australis, now visible only from the southern hemisphere. On Monday, June 2, when the discovery was made it was located at right ascension 23 hours 33 minutes 56 seconds and declination south 32 degrees 48 minutes 33 seconds. It has no plainly visible tail. It is moving slowly southward in the sky at the rate of 24 seconds a day, but its future course in the heavens can only be told after more observations are obtained.

MAKING two trees grow where one or none grew before will shortly become the task of the U. S. Department of Agriculture, when President Hoover signs the reforestation bill, authorizing large sums for tree nurseries in which young seedling trees will be brought to such maturity as to be suitable for replanting cut-over lands, or areas suitable for forests throughout the country. Mounting sums for the work are authorized, ranging from $250,000 for this current year to a maximum of $400,000 annually by 1934. Young trees after they are planted on these reforested areas are to be given governmental protection and care. The Secretary of Agriculture is given authority to require any purchaser of national-forest timber to deposit enough money to provide for the reforestation of the area he intends to cut over, in addition to payment for the timber itself. A number of governmental tree nurseries are planned to be located in various states. The largest will be at Cass Lake, Minnesota.

DOGBANE or Indian hemp, a common weed, has been given a place in the society of plants of economic value. Scientific research, according to the Missouri Botanical Garden Bulletin, has revealed that the weed, known scientifically as *Apocynum*, has rich rubber content. "One of the most significant factors concerning the study of the latex of *Apocynum*," says the Bulletin, "is that the rubber content increases to a large extent with drought and infertility of the soil."

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SCIENCE NEWS

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ASTRONOMICAL VELOCITIES

APPARENTLY speeding away from the earth at the rate of 7,200 miles a second, a faint group of nebulae studied by the Mount Wilson Observatory astronomers sets a new astronomical record. Speaking before the Pacific Section of the American Association for the Advancement of Science on June 19, Dr. Edwin P. Hubble and Milton L. Humason told of their studies which make most previously measured astronomical speeds and distances fade into relative insignificance.

The nebulae studied form what is known as the Ursa Major cluster, and are in the bowl of the Great Dipper, near the star under the point where the handle joins the bowl. Though too far away to be studied in detail, each member of the cluster is undoubtedly a swarm of stars, like the milky way system of which the sun is part.

The observatory's 100-inch telescope, the largest in the world, was the instrument that revealed this high apparent speed. By making a time exposure of fifty hours, on nine separate nights, a photograph was obtained by Mr. Humason of the spectrum of the brightest nebula in the group. This proved to be similar to the spectrum of the sun. The dark lines crossing it, each indicating the presence of a certain element, were not in the position they would occupy if the light came from a terrestrial source. Instead they were displaced to the red end of the spectrum. Ordinarily such a shift is taken to indicate a motion of the light source away from the earth. Such a motion spreads the light waves out, making them longer, or redder. If the object is approaching, they are squeezed together and made shorter or more violet in color.

On such a basis, the shift observed by Mr. Humason was indicative of a speed of the nebula away from the earth of 11,500 kilometers (about 7,200 miles) per second. Previously he had discovered some other record high speeds, such as 7,000 kilometers per second for a group in the constellation of Coma Berenices, 5,100 for a group in Perseus, 3,400 for one in Pegasus and 900 for one in Virgo.

For some years Mr. Humason's colleague, Dr. Hubble, has been studying these nebulae in various ways. It was in 1924 that he announced his first results, which solved an astronomical problem of long standing by proving that these spiral nebulae are actual galaxies of stars, beyond our own system. Though this was done with a couple of the very closest of the nebulae, by methods which could not be applied to the fainter, smaller and more distant ones, he found that he could get a determination of their distance from a measurement of their size or brightness. The nebulae all seem to be of roughly the same size. The small clusters consist of small and faint nebulae, so apparently they appear small only because of their great distance. From comparisons of their size, he has determined the distance of those whose "speed" was measured by Mr. Humason.

Even before the study of the Ursa Major cluster was completed, a direct relationship was found between the apparent velocity and the distance; the farther away the faster the recession from the earth. Using this relationship, Dr. Hubble predicted that Mr. Humason would obtain an apparent speed for the group of about 12,000 kilometers per second, corresponding to its distance of 75 million light years. The most distant stars in our own system are of the order of a hundred thousand light years, a light year being equal to about six trillion miles. When the velocity of the Great Bear cluster came out at 11,500 kilometers, the prediction was abundantly justified. As the relationship holds very closely for all the cases which have been studied, it is believed that the method can now be reversed. By measuring the apparent velocity of a nebula, its distance can be determined.

Just what these high speeds mean is not certain. It is not likely that all the spiral nebulae are seeking to depart from the vicinity of our system, nor is it likely that the farthest ones should be invariably the fastest. More probable is the hypothesis that something happens to the light waves as they travel through space, which spreads them out in just the same way as a motion of the source. The curvature of space, proposed by the Einstein theory, by which space itself is curved in higher dimensions, just as a ball is curved in three dimensions, has been given as one cause of such an effect. At the recent meeting, Dr. R. C. Tolman, physicist at the California Institute of Technology, discussed the possible causes of the effect.

POWER DEVELOPMENT

MAN has nearly reached the limit of development of steam power and will soon discover a new method of transforming energy to his uses. This far-reaching prediction was made by C. F. Hirshfeld, research engineer, of Detroit, Michigan, in an address delivered in Berlin on June 17 before thousands of engineers from all parts of the world attending the World Power Conference.

Scientists can now calculate the limit of power production possible under theory yet to be applied. In fact, they could attain this limit if metals strong enough to stand the increasing pressures and temperatures were available, Mr. Hirshfeld explained. "If we may judge from human history," he said, "this means that somewhere around the corner of time there lies a radically different process for power development. It means that before we have quite reached the limit of possibilities with present methods the new method will appear as an undeveloped infant to be fought over and nourished and carried through the period of adolescence until finally we shall say, 'How simple, why did no one think of it before?'"

Mr. Hirshfeld did not attempt to indicate what the predicted development will be. Apparently he was not

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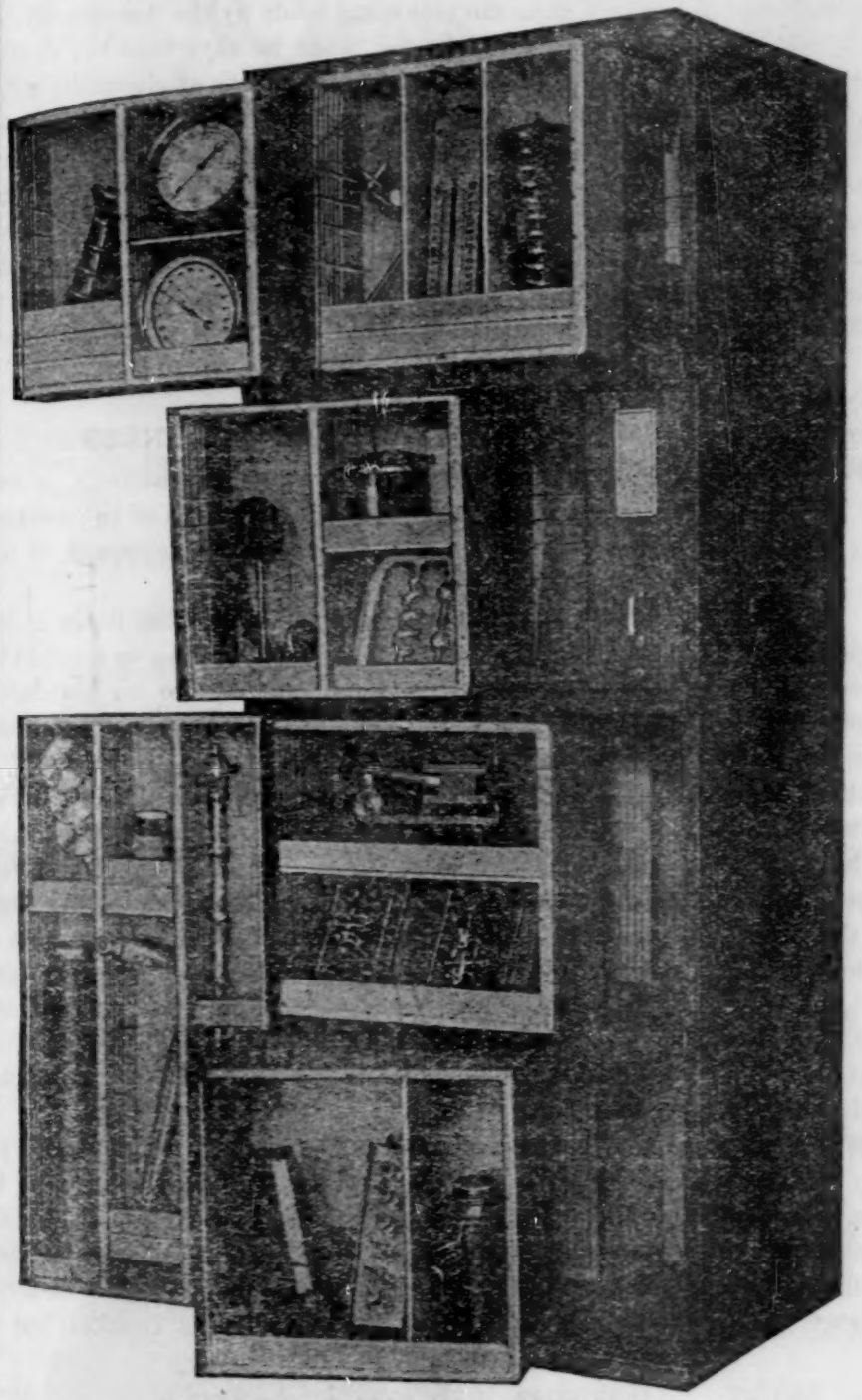

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thinking of power development possibilities which have already been projected, such as the gathering of heat from the sun or the utilization of temperature differences between surface and deep water in the tropics or between sea water and atmosphere in the Arctic to operate a boiler. He said:

"There is no saying where this new development will come nor from whose hands. But, if we follow the path that man has trod thus far, it ought to come out of the fundamental research now in progress or undertaken in the near future.

"With our inherited ideas regarding matter and energy, corpuscle and wave, continuity and discontinuity all thrown overboard or, at least, so modified as to make them all unrecognizable, we appear to have before us a boiling pot out of which something of epochal significance may arise.

"And it is at least conceivable that this may be something that will make obsolete our present power plants before we have had time to find and commercialize metals which will stand the torture to which we are preparing to subject them."

OPTICAL ENERGY

If man paid for optical energy at the rate charged for electricity for domestic use, his vision would cost him less than one trillionth of a trillionth of a cent per second. This energy used every second for seeing is the millionth part of the millionth of an erg. It takes about 1,000 ergs to lift a thirtieth of an ounce only half an inch.

Dr. Charles Sheard, director of physics and biophysical research of the Mayo Foundation at Rochester, Minnesota, spoke of these minute quantities before the American Optometric Association in convention at Boston. He said:

"The retina of the eye is one of the most sensitive energy receivers and detectors known. It may be thought of as a radio receiver, although it does not respond to stimulation by ordinary waves, for it is a very selective set and is tuned to radiant energy of wavelengths within a single octave, lying between four and eight ten millionths of a meter or yard. These waves, like radio waves, travel at a speed of 186,000 miles a second and are the shorter sisters of the much taller ones we have christened radio.

"The sensitivity of the eye is extraordinary. Employing the Einstein equation of the energy required to cause the emission of a single electron with a ray of green light, we may conclude that a single energy quantum for green light is sufficient to excite vision.

"This is saying that the liberation of a single electron in the retina by a green or blue light can excite the sensation of vision in the brain. A millionth of a millionth of an erg per second is the energy or power necessary for vision.

"Since it requires the millionth part of the millionth of an erg to cause the emission of one electron at the retina and thus to set up the sensation of vision, then we know that if these thousand ergs to which we have referred could be used up at the rate of a millionth part of the millionth of an erg, and if there were no dissipation or loss of energy, an eye would have something of the order of a million years of vision. Indeed, it seems almost incredible and inconceivable.

"But the millionth of a millionth of an erg is a mighty small amount of energy. No more startling, however, than the statement made by the American Nobel Prize winner in physics, when he says that the number of electrons contained in the quantity of electricity which courses through an ordinary incandescent lamp and for which one should pay, if such were possible, one hundred thousandth of a cent, is so large that if all of the several million inhabitants of Chicago were to begin to count out these electrons and were to keep counting them at the rate of two a second and if none of them were ever to stop, sleep or die, it would take them just 20,000 years to finish the task."

THE EFFECTS OF DEAFNESS

The individual who loses his hearing entirely, or even partially, is in danger of falling into one of two unhappy states. Either he may become sadly depressed, or else he may become suspicious.

Which way the deafened person is most likely to fall depends on his own personality, according to a report by Dr. Ruth Brickner, of New York, before the Federation of Organizations for the Hard of Hearing, which met recently in New York City.

The person who becomes suspicious is the type known to psychiatrists as a narcissistic person, because of his strong tendency to self-love. Such a man has always been unable to accept criticism, Dr. Brickner explained. He could not be wrong, and yet frequently complains of injuries and slights. He can not accept, or even believe, that he has become the victim of a serious disorder, and so when he gets into difficulties through his defective hearing he is quick to accuse the world of persecution and ridicule.

The man who becomes depressed is the type who has always gone through life feeling dissatisfied with his achievements and highly critical of himself. He has been unable to develop what Dr. Adolf Meyer so aptly calls "resting points of satisfaction." Such a man may rage at his deafness which restricts his freedom, but his rage takes the form of self-hatred.

Both types, if the condition becomes acute, shut themselves away from other people, the first because he suspects people of being unfair to him, and the second because he dislikes to trouble others with his conversational handicap. Extreme personality types and extreme reactions to deafness are not common, but each individual needs to recognize the tendencies and where they may lead.

Study of lip reading was recommended by Dr. Brickner as the first prerequisite to overcome isolation in deafness. Human beings happen to be social beings. Some deafened persons achieve success in social contact with other deafened persons, and in familiar environment, but become panic-stricken when they have to talk with hearing people. Others attain the greater victory of

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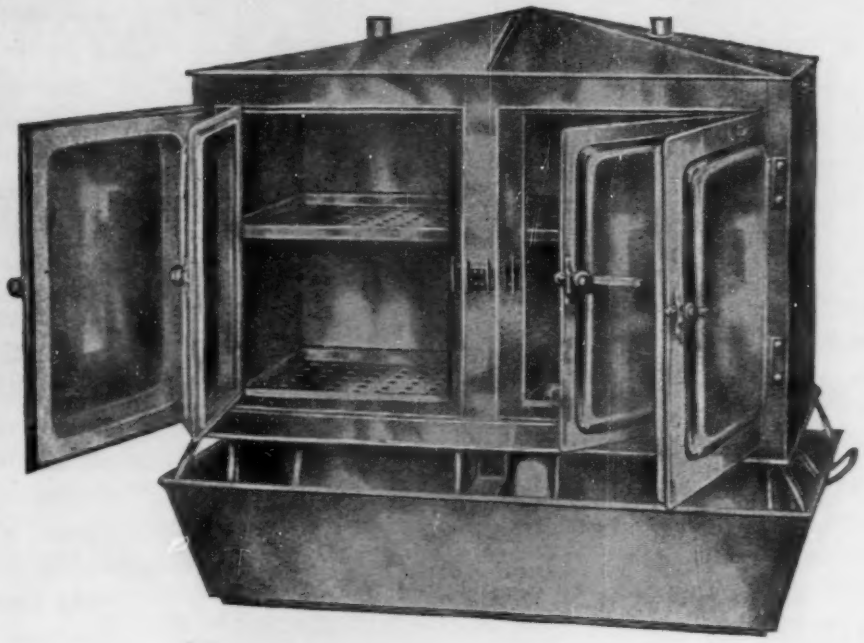

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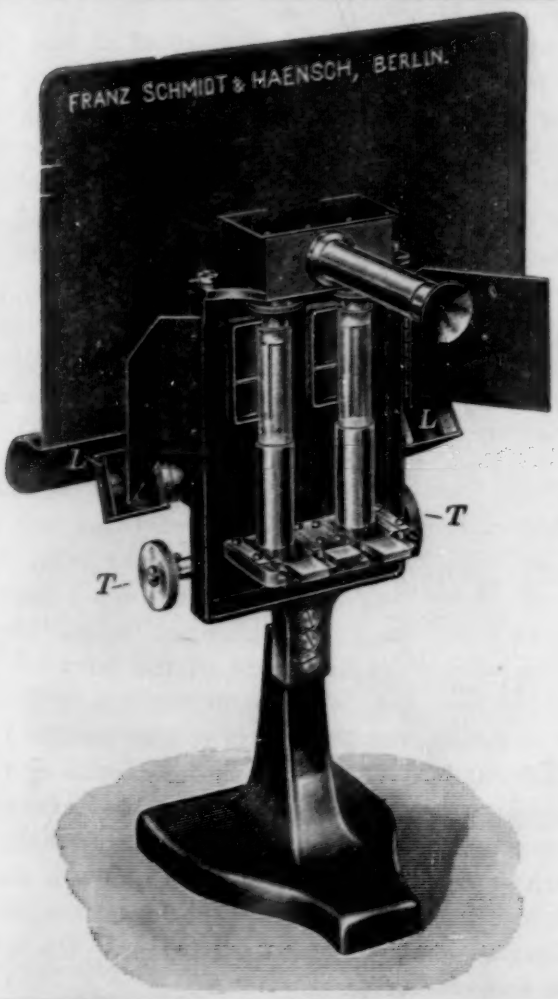

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DEAFNESS FROM OCCUPATIONS

THE possible outcome of deafness as a result of a noisy job was brought to the attention of the Federation of Organizations for the Hard of Hearing on June 19, by Dr. Frank G. Pedley, of the Montreal General Hospital.

A Scottish physician has found that 75 per cent. of boiler makers either could not hear at all at a public meeting, or could hear only with difficulty, and Dr. Pedley's experience with weavers is similar.

"Every one has heard of boiler-maker's deafness, but there are many other occupations in which work is carried on amid a most frightful din, and in which the workers almost invariably lose their hearing."

Among occupations which are hard on the ears are: Spinning, carding and combing in the textile industry, chipping and stamping metals, stone-cutting, tunnel construction, riveting, stoking aboard ship. Some jobs in aviation, testing of firearms, cement manufacture and wood-work were included.

The number of individuals exposed to undue noise runs into hundreds of thousands, Dr. Pedley estimated. Chronic occupational deafness usually creeps on insidiously until some one calls the victim's attention to it. This type of deafness is traced to a degeneration of the delicate receiving apparatus of the internal ear.

More information is needed before a rational program of prevention can be planned. No single noisy plant has yet been investigated to determine the degree of deafness its men attain, the time involved and the intensity of the noise which produced the impairment of hearing.

"Meantime," he stated, "it seems only fair to workers in noisy trades that they be advised of the hazard they are exposed to. I question whether the state has morally the right to permit conditions which destroy the function of any part of the body, and certainly the individual citizen should be informed of these conditions, and given the option of refusing or accepting them."

ITEMS

THAT international boundary barriers of Europe will some day be wiped out by a continental network of electric power lines is suggested by Dr. Conrad Matschoss, director of the Society of German Engineers. A picture of a peaceful, prosperous Europe, with her nations exchanging power on a basis most economical to all, was painted by Dr. Matschoss. "To-day less than two per cent. of the power produced in Europe is exported from one country into another. Europe will not be united by a League of Nations, but by the interpenetration of commercial interests with the exchange of electric power playing an important part."

THE United States has 55,000 miles of pipe lines carrying natural gas to a large part of the industries and homes of the country, and some of these lines extend as far as 400 miles from the producing areas, according to a report by Dr. Gustav Egloff, of Chicago, at the World Power Conference in Berlin. Natural gas is taking the lead in the great change in fuel practice now going on in America which is increasing the use of all kinds of gas. Two and a quarter trillion cubic feet of gas valued at $500,000,000 were produced in the oil fields of the United States in 1929. Its fuel value is equivalent to that of more than one sixth of the coal mined in the country during the same period.

A STATISTICAL barometer will soon register every week the condition of business in the United States. The production of electricity will be the unit of measure. "Electrical production is one of the most accurate, as well as the most immediate, indices of the activity of industry and trade in the United States," according to William Morgan Carpenter, economist of the National Electric Light Association, who spoke before the World Power Conference. "Three quarters of manufacturing enterprises are now electrified and out of every three horsepower of electric motors, two are operated on power procured from the lines of electric light and power enterprises." Plans are being worked out for the gathering of these statistics weekly by the National Electric Light Association, the trade association of the electrical industry.

SILENT welding, which joins metal to metal by fusion, has been used either wholly or partially to replace bolting and riveting in nearly a hundred bridges and buildings of the United States. The tallest building which has been built in this way without the clatter of riveting is the 11-story, 180-foot Hotel Homestead at Hot Springs, Va., Frank P. McKibben, of the General Electric Co., told the World Power Conference. The one having the largest steel tonnage is the welded shop of the General Electric Company in West Philadelphia, in which 987 tons of steel were used. Old buildings and bridges have been welded to strengthen rusted and overloaded beams so that the structures will last longer. Nearly all this work on both old and new structures has been done with the electric arc. However, a large steel building has just been completed in which the oxy-acetylene arc was used entirely.

HAWLEY CARTWRIGHT, research fellow at the California Institute of Technology, has discovered that only a small range of rays, those with wave-lengths lying between 7,000 and 14,000 Ångström units (one ten millionth of a millimeter), will shine through animal tissue. The visible rays, the ultra-violet and some of the infra-red become lost in the flesh and fail to shine through. The significance of this is that these rays can be used to heat the body internally. Hot water bottles and electric pads are localized heaters compared to these infra-red rays that penetrate the flesh and heat it internally. Mr. Cartwright placed a high temperature bulb inside his mouth and with a spectrograph he tested the colors, the wave-lengths, that penetrated his cheeks. His tests were simple and conclusive.

TESTED H L STANDARDS

PURE PROTEINS OF MILK VS. CRUDE CASEIN

THE PURE PROTEINS of milk are so difficult and expensive to prepare, that only too often the crude products are inadvisedly used in researches of importance. One "crude essential element" of the diet may invalidate all other good features of a costly investigation, thereby disqualifying the deduction of the author.

In recent journals such papers have appeared.

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"Casein - Harris" and "Lactalbumin - Harris" have been prepared

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Each protein contains highest nitrogen content, lowest mineral ash, freedom from each other and other substances of cow's milk.

They are made directly from fresh skim milk, which is the only possible way to prepare them in high purity.

Assayed upon growing white rats. Free from all vitamins.

AVERAGE ANALYSIS OF CASEIN—HARRIS

Moisture	10.73	Casein (N x 6.38)	87.09
Ash	.59	Ether-soluble	.20
Calcium	trace	Nitrogen;	
Nitrogen	13.66	water, fat, ash-free	15.44

(cf.—Osborne & Harris, Jr. Am. Chem. Soc., 25-IV, 346)

Also

Purest powdered Medicinal Yeast (standardized for Vitamines "B" (F & G) and Concentrates from this yeast.

Also

Vitamine factors, pure food mixes, deficient foods, salt mix and methods for vitamine assays upon the Norwegian white rat.

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SCIENCE NEWS

Science Service, Washington, D. C.

THE PLANET PLUTO

DEFINITE proof that Pluto, the planetary object recently discovered by Lowell Observatory astronomers, is really a planet revolving beyond the orbit of Neptune has been obtained by astronomers at the Mount Wilson Observatory, as announced by Dr. Harlow Shapley, director of the Harvard College Observatory, which acts as the national clearing-house for news of astronomical discovery.

Because of the slow motion of the planet, all the observations made of it since discovery have not been sufficient to permit an accurate calculation of its orbit. Discovery of several photographic plates taken in 1919 on which the planet was recorded has given the Mount Wilson astronomers the material for a much more precise determination of the planet's path.

Dr. Seth B. Nicholson and N. U. Mayall have calculated the orbit and find that Pluto revolves around the sun once in a year equal to 251.8 of ours. The eccentricity of its orbit is .25, which means that it is an ellipse not very far from circular. A preliminary orbit calculated by the Lowell astronomers indicated that it was an extremely elongated ellipse, while still other astronomers believed that it was still longer and that the planet would take many thousands of years to make a circuit of the sun.

According to the Mount Wilson calculations, Pluto is approaching the sun and will be closest on June 5, 1988. Then it will be 2,700,000,000 miles away from the sun, about the same distance as that of Neptune, farthest known planet until Pluto's discovery.

"This orbit indicates definitely that the object belongs to the solar system, and is a small trans-Neptunian planet, rather than a comet," said Dr. Shapley. "The new orbit satisfactorily represents all known observations of the planet, including a photograph made in Brussels in 1927."

PROFESSOR EINSTEIN ON SPACE AND REALITY

"SPACE will finally survive as the sole carrier of reality," according to a prediction made by Professor Albert Einstein in an address made before the Second World Power Conference which is being attended by engineers and scientists from many countries.

Professor Einstein was introduced to the audience of two thousand which assembled to hear the address, which was the first general feature of the conference program, by Dr. Oskar von Miller, president, as "the Newton of the present day."

He traced the evolution of man's ideas of the constitution of the universe from the days of the old Euclidean geometry which gave a notion of space based on the relations of bodies in connection with each other.

Descartes was the first to introduce space as the general container of the universe. The picture of space as seen by Newton did suffice to describe physical relations until Maxwell introduced his field theory of electromagnetic waves upon which the whole of modern electrical development has been based.

The fact that electromagnetism acts at a distance made the conception and notion of an ether necessary. But, Professor Einstein explained:

"By means of the relativity theory space loses its generality and its structure must be regarded as changeable. There is analogously to Reimann's geometry a mathematical space structure possible wherein metric continuity and direction are united in a four-dimensional reality."

Space was originally derived from physical bodies. This space has annihilated the ether and time. Professor Einstein is now engaged in the formulation of newly developed generalizations which promise to annihilate fields of force, corpuscles and material particles in such a way that the fundamental stuff of the universe will prove to be, not matter as previously supposed, but space itself.

THE ARRANGEMENT OF ELECTRONS IN ATOMS

FROM revealing to the eye the arrangement of the bones in our bodies, X-rays now show how the electrons are placed in the atoms of which all matter is made. For many years physicists have been able to study the arrangement of the atoms in larger aggregations by the use of X-rays, but further studies in the last few years have brought out new facts about the structure of the atoms themselves, Professor Arthur H. Compton, of the University of Chicago, told the American Physical Society meeting at Ithaca.

"Several weeks ago I noticed a beautiful halo around the moon," he said, in explaining the method. "Half an hour later the halo was visibly smaller in diameter, and it was no surprise when a few hours later rain began to fall.

"The interpretation of such haloes, as due to the diffraction of the moonlight by droplets of water suspended in the air, is well known. The larger the droplets the smaller the angle of diffraction necessary for the appropriate phase difference between the rays coming from the two sides of the drop. So by observing the diameter of the halo, we can estimate the size of the water drops which cause it. A shrinking halo means a growing drop and hence probable rain.

"In a very similar manner it is possible to find the size of molecules and atoms in a gas, by observing the diffraction haloes produced when they are traversed by a beam of X-rays. For many years it has been possible by this method to make rough estimates of the sizes of the atoms, but only very recently has the theory of the process become well understood, and the experimental technique become sufficiently developed to give us precise information regarding the electron distributions in atoms.

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Each class is limited to a maximum of 75 students, men and women being admitted on the same terms. Applications may be sent any time during the academic year but not later than June 15th.

If vacancies occur, students from other institutions desiring advanced standing may be admitted to the second or third year provided they fulfill the requirements and present exceptional qualifications.

INSTRUCTION

The academic year begins the Tuesday nearest October 1, and closes the second Tuesday in June. The course of instruction occupies four years and especial emphasis is laid upon practical work in the laboratories, in the wards of the Hospital and in the dispensary.

TUITION

The charge for tuition for 1930–31 will be $600 per annum, payable in two installments. There are no extra fees except for certain expensive supplies, and laboratory breakage.

Inquiries should be addressed to the

Recorder of the School of Medicine, Johns Hopkins University, Washington and Monument Sts., Baltimore, Md.

Graduates in Medicine who satisfy the requirements of the heads of the departments in which they desire to work are accepted as students for a period not less than three quarters. Tuition charge is $50 a quarter.

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Journal of
The Optical Society of America

Published monthly by the Optical Society of America

CONTENTS FOR JUNE, 1930

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F. K. RICHTMYER, Manager
Rockefeller Hall, Ithaca, N. Y.

"When we review the many atomic theories that have been proposed and discarded, it may perhaps appear too bold to say that the particular theory now in vogue has any finality. One by one the vortex ring atom of Kelvin, the positively charged jelly of Thomson, the minute solar systems of Rutherford, Bohr and Sommerfeld, as well as the tiny atoms of Crehore, the ring electron atoms of Parson and the cubic atom of Lewis and Langmuir have given way to more promising successors. We replace even Schrödinger's diffuse cloud of negative electricity by a probability cloud of electrons after the manner of Heisenberg. It now appears, however, that the only one of these many proposals which can account for the observed X-ray diffraction haloes is that of Heisenberg."

After giving details of the methods used in interpreting these X-ray experiments, Dr. Compton concluded:

"We may say with some confidence that the aspect of the problem of atomic structure which is concerned with the distribution of the electrons in atoms is finding a satisfactory solution. It is a relief to note that a theory is at hand which affords a reasonable interpretation of the electron distributions which the experiments show.

"In a bulletin of the National Research Council, published in 1922, having experiments of this character in mind, I had the temerity to predict that within ten years the electron positions in the lighter atoms would probably be known as reliably as were the positions of the atoms in certain crystals. I believe that prediction is now verified. For this information regarding electron positions in atoms is based upon precisely the same principles as is for example our information regarding the position of the oxygen atoms in a calcite crystal.

"I suppose it would be fair to say that experiments such as these come the closest of any yet performed to showing us 'what the atom looks like.' For after all is not seeing an object a diffraction phenomenon similar to those under discussion? And when we thus 'look' at the atom we find it composed of electrons diffusely distributed."

CANCER DIAGNOSIS

PHYSICIANS who took part recently in an informal test showed increased ability to diagnose cancer when compared with physicians who took practically the same test fifteen years ago. The test was held as a part of the three-day conference of pathologists held at the surgical pathological laboratories and the Garvan experimental laboratory of the Johns Hopkins Hospital and University.

The physicians recently did not agree on a single borderline case in their diagnoses of the sections of tumors given them by Dr. Joseph Colt Bloodgood, neither did the physicians who examined similar and in some cases the same sections fifteen years ago. This shows the great need for a stain which will differentiate the cancer cell from other cells, so that it will not be possible to miss it in examining sections from suspected tumors.

The majority of pathologists in 1930 apparently made the correct diagnosis while the majority in 1915 did not. This shows the improvement in physicians' ability to diagnose this disease from microscopic sections. At this conference all the doctors agreed on every definite case of cancer, and all agreed on every definite benign tumor. The disagreement was entirely on the borderline cases. This means great security to the patient facing operation for possible cancer. If he really has cancer and there is a good pathologist in the operating room to make a rapid examination of a section of the tumor, the patient will not get incomplete treatment for cancer.

Occasionally the tumor may be diagnosed cancer when it is not cancer, and the patient will get the operation for cancer when he does not need it. This is the safest mistake that can be made and need not be feared. The dangerous thing is the incomplete operation when cancer really is present. Even the safe mistake, the operation for cancer when cancer is not present, can be prevented if a differential stain for cancer can be developed.

INCREASE IN MENINGITIS

A PROGRESSIVE increase in the number of cases of meningococcus meningitis has taken place in this country during the last five years, Dr. R. C. Williams, of the U. S. Public Health Service, told the state, provincial and territorial health officers assembled in Washington for the recent joint meetings of the Annual Conference of State and Territorial Health Officers with the U. S. Public Health Service and the Annual Conference of State and Provincial Health Authorities of North America.

"It is true that the actual number of cases is not large when compared with the total population," Dr. Williams said. "It is significant, however, that each year there has been an increase over the preceding year and that this rise has continued for five years." No comparable increase has been reported from Europe. The total number of cases reported throughout the United States for the past five years is as follows: 1925, 1,859 cases; 1926, 2,226 cases; 1927, 3,204 cases; 1928, 5,781 cases; 1929, 9,660 cases. During the first twenty-two weeks of 1930, forty-seven states reported 5,400 cases.

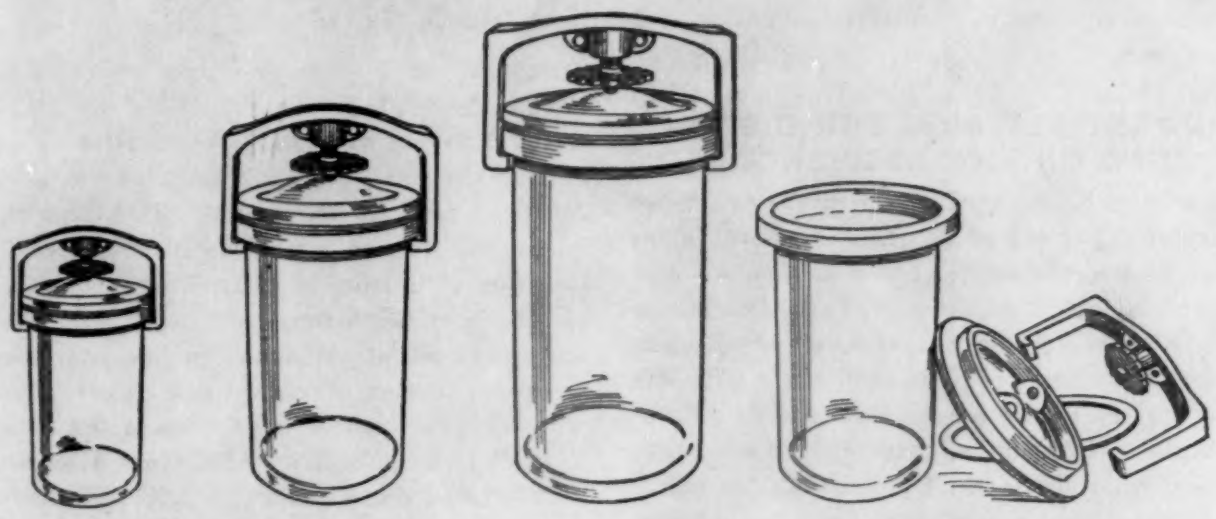
The control of this disease is extremely difficult, Dr. Williams said. Studies conducted in various parts of the country have failed to produce any new methods of importance. The most important preventive and control methods now known are: prompt recognition of cases of the disease, prompt reporting to the health authorities, avoidance of overcrowding, maintenance of high standards of bodily vigor, sterilization of dishes and eating utensils, optimum of fresh air and sunshine for carriers and convalescents.

At an earlier session, Dr. Williams told of a survey which the Public Health Service has conducted in cooperation with state health authorities with a view to establishing a morbidity registration area similar to the birth and death registration area now in existence. The advantage of the morbidity area would be that for the states in the area all cases of communicable diseases would have to be reported. This would make the matter of control and prevention of epidemics much better. Several state health officers described the favorable results of the survey in their territory and it was decided to continue it during the coming year.

Experiments being conducted at the U. S. Hygienic Laboratory in the hope of improving still further the

CYLINDRICAL

MUSEUM JARS



Made of clear, heavy glass without constriction at the neck so that the width of the mouth is the same as the inside diameter of the body of the jar.

The contents are enclosed entirely in glass, with a rubber gasket between cover and jar to make a tight joint. A metal clamp with screw fastener maintains a secure seal and at the same time offers ready accessibility to the material or specimen without the difficulty of opening a permanent closure as is the case with the ordinary rectangular museum jar.

On the under side of the cover are two glass rings, from which specimens may be suspended so that they will stay in any desired position.

10222—Museum Jars, as described above:

Diameter, inches		2¼	2¼	3½	3½	3½	3½	5
Height, without lid, inches		4	8	6	8	12	18	8
Capacity, pints		½	1	1¾	2½	4	6	5½
Each		1.30	1.45	1.90	2.00	2.40	2.85	3.65
Per dozen, 15% discount.								
Diameter, inches	5	5	6¼	6¼	7⅝	7⅝	7⅝	7⅝
Height, without lid, inches	12	18	8	12	8	12	18	24
Capacity, pints	8	12	8	12	12	18	28	36
Each	4.32	5.00	4.68	5.20	7.20	8.20	9.60	11.00
Per dozen, 15% discount.								

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present method of immunizing susceptible persons against scarlet fever were reported by Dr. M. V. Veldee. At present, from 96 to 100 per cent. of susceptible persons can be successfully immunized if they are given adequate treatment with the scarlet fever toxin already developed by various scientists. The immunity has been proved both by skin tests for susceptibility and also by the fact that children so immunized came through scarlet fever epidemics without acquiring the disease. How long the immunity lasts is not known, but it is thought to last three or four years.

GOVERNMENT REWARDS FOR DISTINGUISHED SERVICE IN SCIENCE

A BILL shortly to be reported out from the committee on the library of the House of Representatives will allow the President to decorate men and women who, while in the employ of the federal government, have "made outstanding contributions to the advancement of scientific knowledge or the application of its truths in a practical way for the welfare of the human race and to citizens who, while in the employ of the federal government, have rendered conspicuous service to humanity at the voluntary risk of life or health over and above the ordinary risks of duty."

There will be two medals. For the investigator who has made a specific contribution to the knowledge of the world, there will be the Thomas Jefferson Medal of Honor for Distinguished Work in Science. This medal is named after the President of the United States who was an early patron of science, who engaged in some scientific work and who sent Lewis and Clark on their famous explorations.

The Jesse W. Lazear Medal of Honor for Distinguished Self-Sacrifice for Humanity will be the medal which would be awarded to those who risk life and health bravely that the cause of science may be advanced. This medal is named after the physician who, as a member of the famous Yellow Fever Commission, allowed an infected mosquito to bite him and give him a fatal case of the disease which was conquered through the information that this and similar heroic sacrifices gave to medical science.

Only three medals in each class will be awarded each year by the terms of this bill, and the National Academy of Sciences will pass on names recommended to it by heads of departments and independent offices of the government.

It is conceivable that one person might be awarded both medals, either in one year, or in different years. The honored persons receiving these medals and decorations would, in addition, receive $1,000 each.

It is said that the bill will probably pass at the next session of the Seventy-first Congress, beginning in December.

ITEMS

THE photoelectric cell, that has made possible both talking movies and television, is slowed up when infra-red light, consisting of waves too long to be noticed by the eye, falls on it. At the meeting of the American Physical Society, Dr. A. R. Olpin, of the Bell Telephone Laboratories, announced results of recent experiments. The active part of the cell is a layer of metallic sodium or potassium. When visible light falls on this layer, electrons are emitted, and give rise to the photoelectric current, which varies in strength with the intensity of illumination. Dr. Olpin explained that when a cell is operating, by excitation with visible light, the current may be reduced as much as fifty per cent. when infra-red light falls on the cell.

RESULTS of a seven-year fight to check deafness in children and adults were described by Dr. Harold M. Hays, chairman of a special committee on the hard-of-hearing child and the adult deaf, at the meeting of the American Medical Association. In 1923 when this committee was formed there was little interest in the conservation of hearing in children of school age. Now in almost every state some action is going on to interest health and school authorities in this vital subject. The group audiometer, which was comparatively unknown five years ago, now makes it possible to test the hearing of forty children at a time. Dr. Hays described the work that is being done among the 3,000,000 deafened school children in the United States.

A POPULAR course on mental diseases should be part of a well-rounded college education, in the opinion of Professor Jean Piltz, of the University of Cracow, in Poland. Professor Piltz, who has been visiting this country, has found that when university students take such a course, they not only learn to recognize unhealthy mental and nervous states in other people, but they also are aroused to improve their own mental health. Courses on mental diseases of children, given for school teachers and school physicians at the University of Cracow, have shown the value of careful popularization of this subject.

COMPLETELY equipped for the taking and finishing of "talkie" films, a new sound picture laboratory of the Bell Telephone Laboratories is now in use. By duplicating the conditions met with in actual practice, it is expected that further improvements in sound motion picture technique will be made. The sound stage provides a floor space of 70 by 49 feet, and is fully connected for lights, microphones, camera motors and all the other necessary accessories. At one end is a monitoring booth, where the operator can regulate the sound from each of the microphones. This is on a balcony, and opens into a large monitoring room, where full-sized loud speakers reproduce the sounds as they are recorded, and also provide for the "play-back" from one of the records immediately after it is recorded, for the benefit of the director and actors. A projection booth at one end of the sound stage, just below the monitoring booth, provides for recording a musical or sound accompaniment to silent pictures. Full equipment is provided for recording on either wax records or film, and for developing and printing the film after exposure. A projection room with standard projection and reproducing equipment permits viewing of the films. Air-conditioning equipment makes the best atmospheric conditions in all rooms.